FOUNDRY TRADE JOURNAL

EST. 1902

WITH WHICH IS INCORPORATED THE IRON AND STEEL TRADES JOURNAL

VOL. 103
No. 2139
Registered at the G.P.O. as a Newspaper

OCTOBER 10, 1957
Offices: John Adam House, John Adam St., London, W.C.2

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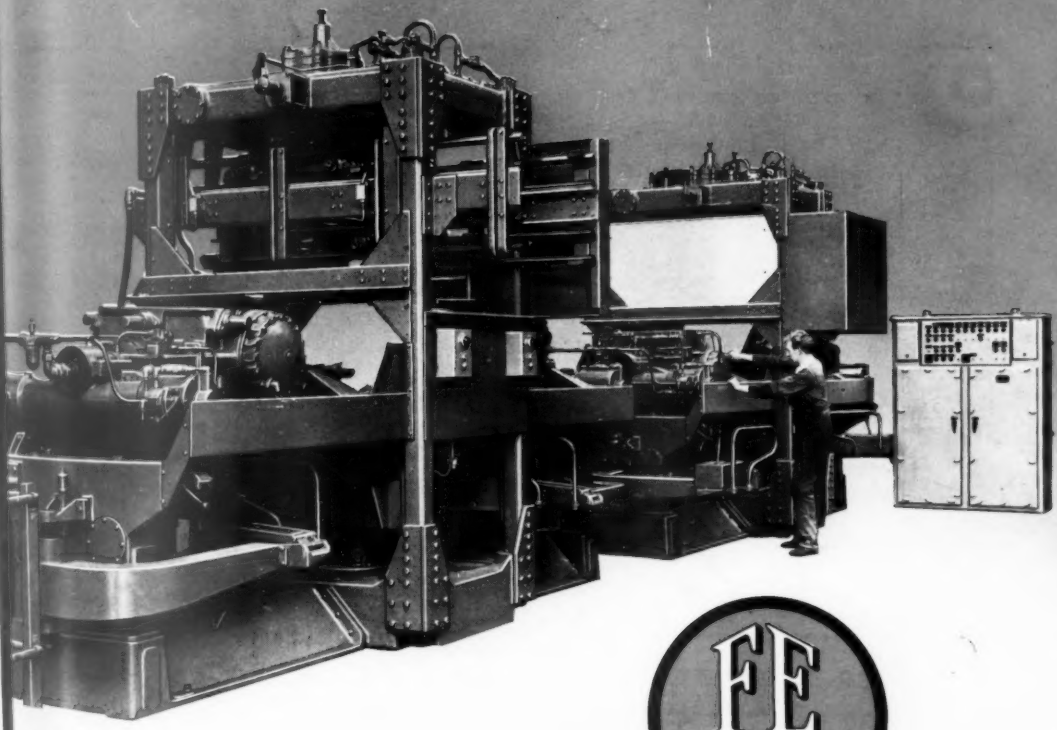

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Established 1902

Vol. 103 Thursday, October 10, 1957 No. 2139

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AN INDUSTRIAL NEWSPAPERS PUBLICATION

Published Weekly
Single copy 1s.; by post 1s. 4d.
Annual subscription: home 52s., abroad 60s. (prepaid).
17/19 JOHN ADAM STREET, ADELPHI, LONDON, W.C.2
'Phone: TRAfalgar 6171 (10 lines)
'Grams: Zacatecas, Rand, London.

European Free Trade Area

"A Joint Report on the European Free Trade Area"* has just been issued by the Association of British Chambers of Commerce, the Federation of British Industries and the National Union of Manufacturers. Rightly, it says that in business circles, there is no generally accepted concensus of opinion as to the merits of the European Free Trade Area as a whole. For one thing, the scheme is at present ill-defined; its application is to be spread over 15 years and thus opinion must be of a hypothetical nature. Then again, the impact of the project will obviously have quite different repercussions on not only various types of concerns, but also in the several departments these concerns operate. It would appear that the Treaty of Rome, passed over the tariff policy of the signatories to a supra-national body called the European Economic Community. This is, or rather will be, a potentially great power in world economics. However, the Report states "There is no question of the UK being forced by the existence of the EEC to seek association with it at any price. The final judgment can only be taken when it is known, as a result of the forthcoming negotiations, just what manner of association is envisaged, and just what form a European Free Trade Area that the UK might join would take."

Obviously, the views expressed in the Report are provisional, for much will depend on the safeguards imposed. One phase of activity, that of rail, road and inland-waterway transport, has received some detailed consideration. This is because the manipulation of the rates charged can act as an invisible tariff—either to aid exports or impede imports. The Report suggests that all railway rates should be a true reflection of costs—that is, not *ad valorem* as has been the case in the past, but on what it actually costs to handle the goods—and that it should be left to the customer to choose the form of transport best suited to his needs. There is a useful note as to road transport, as "international road traffic may be inhibited by rules and regulations of the different countries: for example, regulations as to the size and load capacity of vehicles could be used as a weapon of discrimination."

Another matter dealt with at some length is "hard-hit industries" and the Report suggests that the time is ripe for the Government to make its attitude to these quite clear and state the nature and scope of whatever action it proposes to take to deal with the situation. This subject is elaborated at length, as it is of considerable importance, especially as "escape clauses" can bring in more difficulties than they are designed to cure.

* Price 2s. 6d. from the Federation of British Industries, 21, Tothill Street, London, S.W.1.

National Brassfoundry Association's Jubilee

Addressing members of the National Brassfoundry Association in Birmingham on September 28, on the occasion of their diamond jubilee banquet, LORD MANCROFT, Minister without Portfolio and a vice-president of the British Chambers of Commerce, urged the need for publicity on the part of industry and commerce. The man in the street must be brought into the picture, he said, and firms must raise the cloak of mystery that surrounds them and follow the lead of the Stock Exchange, Lloyd's, and other national concerns which have begun the policy of letting laymen into their affairs. "I think a great deal of opposition comes from the fact that people do not understand," Lord Mancroft went on; "the more companies who tell the people and their employees about their concerns, the more the public will appreciate the true position and such procedure will remove much apprehension." Too many members of the public were inclined to think that 90 per cent. of the industrialists were "lunching on the firm and rolling around in luxury cars," he said. A start in checking this ignorance could be made by publishing less-involved company reports in newspapers. He had recently read a number of company reports in a newspaper and about half of them failed to record in simple language whether the firm had made a profit or incurred a loss. They also failed to state what services the company "sold."

European Free Trade

Lord Mancroft, who was chief guest at the banquet, also had something to say on the European Free Trade area. Britain had no choice but to join, but there was some anxiety about the consequences of removing protection from industry on the home market, he said. "Much of this anxiety was based on the assumption that the UK had the option of staying as we were, or staking its prosperity in a great gamble in Europe," he said. Whatever happens, we just could not afford major and to some extent painful re-adjustments to what was happening in Europe, and no amount of protection on the home market could assure the survival of British industry if it could not compete overseas, he added. What the Government was trying to do was to ensure that British industry shared some of the benefits of freer trade. It meant accepting risks, but they were risks which had to be faced anyway.

MR. A. H. WILSON, president of the Association, said that while the present generation might suffer during the painful process of readjustment, it was probable that the next generation would benefit and if the ultimate dream of a United States of Europe was finally achieved, the sacrifices would be worthwhile. The brassfoundry industry did, however, look upon the proposals with some uneasiness, Mr. Wilson said. Not only would founders have to go out and fight for business on the Continent, but also they would have to fight Continental competition in their own market, he added, referring to competition not only in price but also in design, which was a factor of ever-growing importance in the trade.

On the Restrictive Trade Practices Act, Mr. Wilson said that the brassfoundry industry was resilient and healthy, with craft as its background. A large proportion of the membership was made up of small units managed by capable men with personal drive, who were in constant touch with the needs of their own particular businesses. This made for maximum flexibility, Mr. Wilson went on. Many, however, felt that, in the current legislation, industry was being offered on the "sacrificial altar" of politics. The Restrictive Trade Practices Act broke down at one blow what organizations such as the National Brassfoundry Association had painfully built up over the years and in the light of bitter experiences. Many of the country's great industries, he continued, have been built up through the medium of associations as a common meeting-ground for the discussion of problems and prices. It must not be overlooked that in times of boom and shortages many trade arrangements had been instrumental in keeping prices on an even keel to the benefit of the public.

The LORD MAYOR OF BIRMINGHAM, ALD. J. J. GROGAN, congratulated the industry on the excellent relations between management and employees.

Other speakers at the banquet included Mr. F. L. Davis, vice-president of the National Brassfoundry Association, Sir Norman Kipping, director general of the Federation of British Industries, and Sir D. Finnemore.

Works Visits Day

Successful IBF Function repeated in Glasgow

Like its seven predecessors, the annual Works Visits Day organized by the Institute of British Foundrymen held last Friday in the Glasgow area, was an unqualified success. About 115 foundrymen participated in the series of visits (arranged in pairs of works for morning and afternoon) and the fact that over one-half of these journeyed to Glasgow from south of the border indicates the popularity of the event.

Much appreciated was the fact that the Scottish organizers, headed by Mr. A. Marshall, secretary of the local branch of the Institute, had scheduled quite early departures from central Glasgow to the various works. This, and the mostly short travelling distances meant that there was ample time for really browsing around the plants visited. In fact, at both works toured by the writer, the parties were "turned loose" with their guides (about one guide to six or seven visitors) to wander around the shops and linger at just which points provided major interest.

Dinner

After the visits, the parties of foundrymen, accompanied, for the most part, by members of the host firms (total about 130) forgathered at dinner in the Grand Hotel, Glasgow. Here, Mr. A. S. H. Sawers, president of the IBF, Scottish branch, took the Chair, and it was he who after the meal officially welcomed members and friends. The thanks of the parties of visitors to their hosts from the various firms and also to the organizers, were expressed by Mr. J. Blakiston, M.I.MECH.E., president of the Institute, and Mr. J. W. Douglas, managing director Argus Foundry, Limited, responded for the firms.

Another pleasant feature of the evening was the presentation by Mr. Blakiston of the "John Bell (Travelling) Scholarship" of the Institute to Mr. R. Thomson, B.SC. (Hons.), A.R.I.C. Mr. Thomson—who attended Paisley Grammar School and was a student apprentice at Babcock & Wilcox, Limited, before graduating from the Royal College of Science—intends to use his IBF award for touring works in Germany.

The evening was concluded with light entertainment from John Hynds, tenor, and James McInnes, baritone, accompanied by Gordon Scott Dixon at the piano.

Malleable Production at the Nacton Foundry of Ransomes, Sims & Jefferies, Limited*

By H. A. Wincer

Mr. H. A. Wincer was last session's president of the East Anglian section of the London branch of the Institute of British Foundrymen and has since taken over the duties of section secretary. He was educated at the Ipswich School and later at the Ipswich School of Technology, joining Ransomes, Sims & Jefferies, Limited, in 1948 where he is at present foundry manager. Originally, he intended to follow a professional career, but after the war, in which he served as a pilot in the RAF, he made the change and studied foundrywork and management.

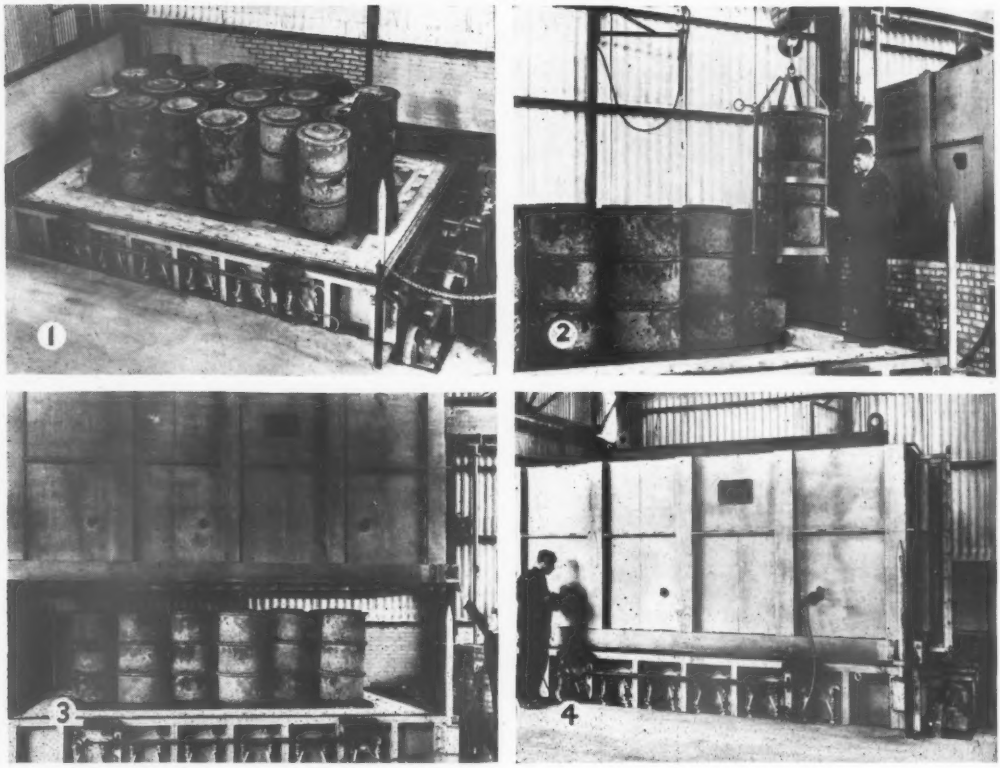
This paper is a brief account of the Author's firm's initial venture into the production of malleable castings. To those readers who have been producing malleable castings for years, the account of the "discoveries" may seem elementary, but it should be remembered that, at the time, none of the members of the firm had had any practical experience in this field although, of course, the staff had studied the subject and sought advice where they could. Malleable production did not start overnight or, indeed, over years. Before the firm left the old Duke Street foundry in 1949, experiments had been made with various metal mixes, and the castings produced at the end of the day—either for blackheart or whiteheart—were generally sent to friends in the industry for annealing. When the castings were returned, a note was often enclosed as to why the material was not up to standard. At the firm's new Nacton Foundry interest was shown in all these experiments and results, but the actual decision to produce malleable castings on a commercial scale came from the firm's Board, and in some way was caused by a paradox. The firm's outside suppliers of malleable castings were heeding the call for increased production and this meant their embarking upon schemes of mechanization. The more mechanized a foundry becomes, the less flexible it becomes, and the less popular are short runs. By the standards of these larger malleable producers, the orders from the Author's firm for malleable castings could hardly be called production runs, and the orders for castings for spare machine parts, especially for their older models, were definitely not wanted by outside suppliers. Yet supplies of spare parts were essential, as the company's policy was to keep its products in the field serviceable over many years. As the ultimate result, the staff were asked to prepare to produce malleable in the foundry at Nacton. What follows is a step by step account of the plant and equipment put to use for this purpose, the methods developed and the results of early experiences.

The definite decision to produce malleable-iron castings at the Nacton Foundry was made in 1951, along with a plan to instal a pilot plant. This was a very interesting time for the staff as they had to procure positive facts and figures as to metal compositions, annealing temperatures and cycles, types of annealing ovens, runners, risers, patterns, etc. The installation of an annealing oven was the first essential to enable the firm to produce malleable castings. After a meeting with the works manager, foundry manager, plant manager, metallurgist, etc., it was decided that batches of about five tons of castings would be most suitable for this early stage, and with production of this order, it should be possible to prove their capabilities. What type of oven should be installed was the next question. A reliable oven with the simplest operating features and one from which consistent results could be obtained was aimed for. This latter point was paramount because in those early days, the firm was not in a position to differentiate between faults caused by oven idiosyncrasies and the snares and pitfalls of the production itself.

Annealing Oven

For ease of operation, with the minimum of supervision, an oven fired by town's gas, with an electronic controller, was agreed upon. Catalogues, drawings and other literature were studied, which covered every shape and size of oven. Finally, the choice was cut down to a "lift-off" or "top-hat" type of oven. Ovens of this type and make were already operating at a foundry in Glasgow, though here they were being used for stress-relieving chilled rolls. The manufacturers of the oven knew of none of their ovens being used for malleablizing so three members of the staff from Nacton Foundry went to Glasgow to see the furnace installed there. The hearth of this model of oven was 12 ft. 9 in. long and 7 ft. 6 in. wide, with a height to the spring of the hood of 4 ft. 4½ in. A steel casing, lined with lightweight refractories, 9 in. thick, forms the base and hood, and there are 24 vertical luminous-flame gas-burners for firing, connected by thimble Calorized-steel recuperator tubes. The visit of members of the staff to see this oven in operation proved that it would do all that was required, but the problem of how it was to be loaded was revealed. Fig. 1 shows the oven hearth with the top removed. On this hearth, it was planned to load the tiers of annealing pots in three rows of six, three pots high, using a fork-lift truck. However, the size of the span from one side to the other, the fact that the hearth was above floor level, and the fact of the well in the hearth itself prevented this idea. A very simple and effective

* Paper presented to the East Anglian section of the London branch of the Institute of British Foundrymen.



FIGS. 1 *to* 4.—*Portable-cover type of annealing oven of five tons capacity. Fig.* 1 *shows the cover removed, Fig.* 2 *a tier of pots being lowered on to the hearth in a special cage. Fig.* 3 *indicates the refractory-lined cover being lowered on to the furnace hearth* (*lugs on the cover slide on guide-pins on the hearth*), *and Fig.* 4 *is of the closed oven. The controlling thermocouple is positioned in the top and other thermocouples in the side walls are connected to a recorder.*

loader was then designed in the Nacton works, shown in Fig. 2. In essentials, it is a fabricated cage with two moving lugs at the base—these lugs being operated from either side by means of a slide. In use, the cage, with the lugs retracted, is placed over a tier of pots, the lugs engaged under the stool, and the whole lifted by overhead crane. Fig. 3 shows the furnace hood being lowered and Fig. 4 the oven closed.

Intermediate Considerations

With the oven on order and the delivery date getting nearer, the firm turned their attention to patterns, and even more important, to orders for castings. Quite a few patterns were called in from the outside suppliers. These in most cases were found to be old and in very poor state of repair and much work was needed before they could be made serviceable again. A problem ranking second to that of patterns was the size of the orders for castings being received. It was obvious that to produce enough spare-part castings in ones and twos to fill the 5-ton annealing oven would be quite difficult without some longer running jobs to make up the weight. Quite naturally, the production departments, with machine-building programmes and delivery dates to meet, were not keen for some of the more-frequently-used repetition castings to be changed to "Nacton malleable."

It should be explained that Nacton foundry serves five works, each with its own products and before starting the production of malleable, the firm were already producing grey iron, high-duty iron, white iron in the general foundry, and mixing two "chilling" irons giving a 1.0 per cent. silicon range in the ploughshare foundry. During the introductory period, the firm had formed an idea of what metal composition should be used. First, it had to be decided whether to produce whiteheart or blackheart, the decision being for whiteheart, as melting would be in a cupola and pouring direct—for the majority of the castings a material giving

high tensile rather than elongation was thought to be better. With this end in view, suitable pig-iron was purchased and "returns" synthesized on which to base the mix. In December 1951 the firm "ran down" some metal of Si 0.89 and Mn 0.55 per cent.; with this and percentages of Barrow hematite, malleable scrap and steel scrap, a mix was made up to give metal of an estimated composition Si 0.77 and Mn 0.48 per cent., and a few castings were produced. These were sent away for annealing (as the oven was not by then installed). But although they were malleable on return, they were not quite satisfactory.

The oven started to take shape in 1952, and the firm's attention was turned to annealing. Friends "in the know" were visited and their advice sought as to procedure. New hematite ore and "spent ore" for packing the castings during the annealing, was obtained, and the founders were then in a position to start producing what they hoped would be whiteheart malleable. On March 17, 1952, the first full cast was made—nearly 30-cwt. of castings—the length of the melt being limited by the number of patterns in use and the number of moulds that could be cast before the cupola "caught up" and had to be kept standing. At the time of these malleable trials, a 24-in. dia. cupola was being used every afternoon for melting high-duty cast iron, and it was decided to use this same cupola for malleable, before melting the high-duty iron, thus providing a clean furnace and avoiding the waste of bed coke in running a special cupola. Later, when trying to fit in with other production requirements, the firm tried melting malleable in the same cupola following the high-duty iron, but the quantity that had to run down before the malleable composition was correct made this an uneconomical proposition.

Control Instituted

To keep track of the run of the melting, and to enable results obtained from the various melts to be compared fairly accurately, a series of square test-pieces were cast 2½ by 2½ by ¾-in. and this practice is still followed to-day. These test-pieces provided samples for analysis, and were numbered and dated and cast at regular intervals through the melt; the results of the first melt being shown in Table 1. Sticks or sprues of ¾-in. dia. were also cast during the run and these were broken as soon as practicable to give an idea of how the melt was running and to show if there was any mottle. Runners were also broken from the castings for an additional check. It was found that if mottle showed in the centre ½-in. dia. of the ¾-in.

TABLE I.—*Analyses of Samples Taken During the First Malleable Melt.*

Sample No.	Total carbon	Silicon	Manganese
1	3.6	0.615	0.27
2	—	0.55	—
3	—	0.55	—
4	3.41	0.52	0.20
5	—	0.46	0.21
6	—	0.43	0.19
7	—	0.51	0.18
8	3.39	0.39	0.17

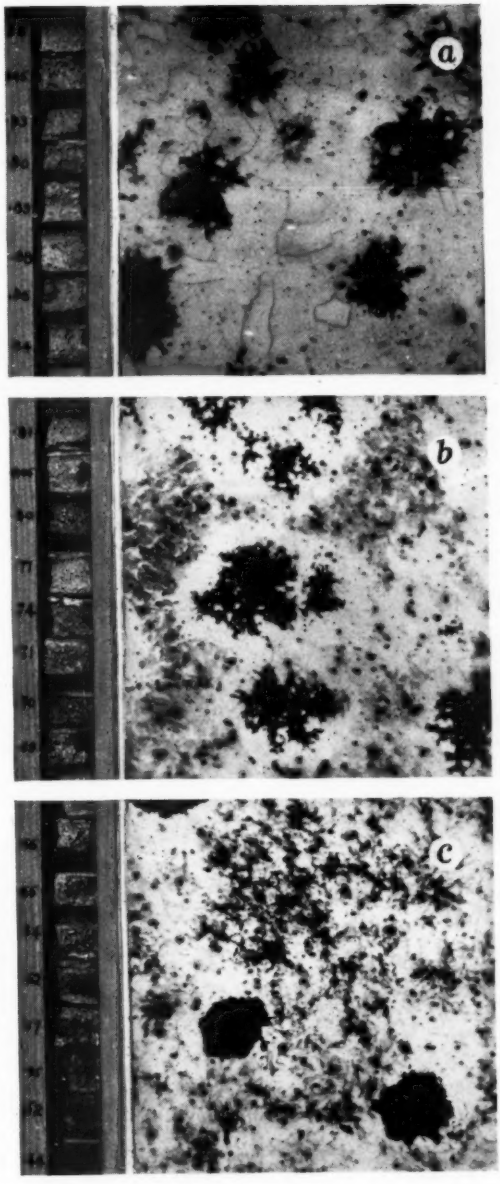


FIG. 5.—*Fractures (left) showing the results of various sulphur : manganese ratios in whiteheart malleable test-pieces prepared at Nacton Foundry. Alongside are photomicrographs showing the types of structure obtained with (a) excess manganese, (b) sulphur and manganese balanced, and (c) excess sulphur.*

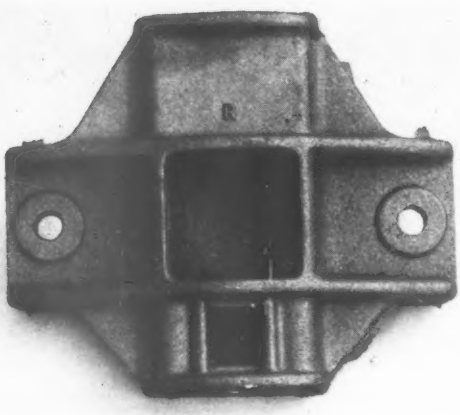


FIG. 6.—*Bracket casting which presented a problem due to cracking. At the centre there is a box section and a crack can be seen on the left side; all the cracking occurred on the bottom plate.*

sprue, mottle was likely to occur in the centre of sections ½-in. thick and over.

Four casts were made prior to April 10, and during the intervals between casts, experiments were made with packing for annealing. An ore mix of four parts old and one part new material was used. Much speculation was entertained as to how many castings should be put into each pot, and how best to pack them so as to minimise distortion. The actual first lighting of the oven proved uneventful; the top was lowered and annealing commenced. The soaking temperature had been fixed at 980 deg. C., the calorized recuperator tubes in the chamber under the hearth having a top limit of 1,000 deg. C. After lighting, the temperature of the oven rose steadily all day and at 6 p.m. (when it was left) it had reached 800 deg. C. Up to this time the temperature indicated by the controller and recorder had kept in step, but at 11.30 p.m., when a check was made, the controller stood at 850 deg. C., with the recorder at 1,050 deg. C. A quick examination revealed that a mechanical fault in the controller had jammed the indicator-needle rendering it inoperative, and so the first cycle was completed with the oven controlled manually. At the end of the annealing cycle, the hood was raised and, although at an uncomfortable temperature, a tier of pots was removed. One pot was opened and some castings abstracted. With fingers crossed, a rough test of quality was made by hitting them with a blacksmith's heavy hammer. They bent, proving that malleable had been made at Nacton works for the first time !

Instrument Correction

Instrument makers were called in later to correct the controller. The fault proved to be a very simple one although it could have had extremely serious consequences. The controller is of the electronic type and its principle of operation briefly is as follows. A pair of coils is mounted on the temperature-setting pointer-movement, which move in sympathy with the required temperature setting. These coils are so connected with the double-triode (thermionic) valve and the electrical relay that when the indicating pointer is below the required temperature, the relay contacts are made. Attached to the indicating pointer is an aluminium vane which, as the required temperature is approached, enters the two coils mentioned previously. A further increase in temperature causes the vane to move between the coils and causes an out-of-balance between the two coils, which in turn releases the relay which then shuts the motorized gas-valve to the by-pass position. The fault which caused the trouble during the first attempt at producing malleable at Nacton foundry was the bending of the aluminium vane whilst the instrument was in transit. This led it to foul on the edge of the coils instead of passing between them. The instruments had been tested to 800 deg. C. during the day, but the trouble only occurred when the higher end of the temperature scale was reached.

Other "Teething Troubles"

In the first anneal, two test-bars, one of dimensions 8 by 1 by ⅜-in. and the other a standard tensile bar, were packed into each pot. These test-bars were cast all from the same ladle of metal and the purpose of including them in this manner was to determine whether there was any difference caused in the bars which could be attributed to different thermal behaviour of the various areas of the oven. Similar test-bars, but cast from various melts, were also packed into the pots. The outcome of these tests was that it was proved that there was no difference in the oven between the ends and the centre, and meant that the operation of the oven was as simple as it had hoped it would be. On breaking the test-bars, however, instead of finding a whiteheart fracture, it was a coke black. The metal composition was checked and other enquiries made, but without any positive result. The making of castings continued, however, and all was prepared for a second anneal. From this, the first three test-bars broken were very good indeed, but the fourth was like the earlier ones, proving that a solution to the trouble had not been found. This state of affairs continued, with various fractures being obtained, no

FIG. 7.—*Another design of casting with which cracking trouble was experienced. The ribs, the incorporation of which alleviated the problem, are shown picked out with chalk. In this instance, the ribs were left in place after fettling, but with other castings, they are ground off.*

reason being found as to why the required fracture could not be guaranteed. By this time also, a considerable number of test-bars 2½ by 2½ in. had been collected, all dated and marked, together with analyses of each. These bars were then placed together in one pot and annealed. After annealing, a small strip was cut from each and fractured. The resulting fractures gave a range from black to steely white. These were now checked against the analyses recorded and the results were found to compare exactly with the S:Mn ratio. With a ratio of 0.58, the sulphur and manganese are in balance. Below a ratio 0.58 to 1.0 there is an excess of Mn and above 0.58, an excess of S. The lowest ratio obtained was 0.45 which gave a black fracture and from there, the fractures could be graded up to the 0.98 ratio, as shown in Fig. 5. The corresponding microstructures are shown in Fig. 5 (*a*), (*b*) and (*c*); (*a*) shows a fracture of ferrite with graphite rosettes caused by excess of Mn; (*b*) shows the rosettes again but with ferrite and pearlite caused when S and Mn are in balance; and (*c*) with excess S, shows the changed formation of the graphite in a mainly pearlitic matrix.

New Approach

With this new knowledge, it was felt that much progress had been made. By consulting the collection of "master" fractures, it was possible to estimate the S:Mn ratio by fracture, and by adjustment of the metal mix, a true whiteheart fracture could be produced. The average result obtained from test-bars at this time was: tensile 24.5 tons per sq. in. and elongation 6 per cent.

Trouble with Cracking

As progress was made, so the seleetion of patterns used in production increased and the problem of cracking was next encountered. A particular casting prone to this trouble is shown in Fig. 6. The first batch of these castings were all cracked, either immediately after casting or after annealing. After one anneal, however, one or two sound castings were found; it is unusual to break up good castings, but in this instance, the sacrifice was made and with good result. Each of the good castings showed a fracture indicating an excess of Mn and this discovery opened up a new line of thought. The result was that supplies of ferro-manganese were obtained and it was estimated how much of this material should be added to a ladle of molten metal to reduce the S:Mn ratio of the standard mix, to give an excess Mn instead of the, by then, customary, excess sulphur. This addition was made and after annealing, the castings were examined carefully. The castings made from the standard mix showed cracks but of those carrying the excess Mn, 90 per cent were sound. While experimenting with varying S:Mn. ratio in this way, no trouble was encountered with the formation of mottle* in the as-cast condition.

Cracking troubles were still encountered with some castings and in the main this was caused, it was thought, by the design of the casting. To counteract this type of defect, small ribs were incorporated on certain patterns (for example see Fig. 7). After annealing the casting, unwanted ribs may be ground off. Despite these devices, there seem still to be a number of castings still prone to cracking and for these the only solution seems to be to provide a muffle furnace into which castings may be put as soon as possible after casting and there allowed to cool down very slowly. Without such a muffle furnace, limited success has been obtained by the Author by a form of stress-relieving in a mould-drying stove. By such means, it has been found that a casting which has shown a tendency to crack during annealing is more likely to remain whole if first put into the mould-drying stove for a few days. This, of course, must be regarded only as an expedient.

When the production of malleable in Nacton foundry was becoming part of the regular routine, it was found that during week-days, the cast had to be limited to 1½ hours, because after this period, the cupola was melting metal faster than moulds could be produced and any hold up on the cupola caused the composition to deteriorate substantially. It was found, in fact, in all the melts that there was a reduction in the Si content as the melt progressed, and to correct this, a proprietary Si briquette was added to each charge after a certain number; this procedure has proved very effective.

Meeting Increasing Demand

The size range of the malleable castings made at Nacton is shown in Fig. 8 and the demand for these

* See "Influence of the S : Mn Ratio on the Occurrence of Mottle in Whiteheart Malleable Iron," by S. W. Palmer, British Cast Iron Research Association, *Journal of Research and Development*, vol. 4, No. 8, 1952. The present Author considers his salvation in this respect was the Si content of the metal for, as Palmer stated, "Mottle, may, however be offset by one of the following methods according to section size:—(1) A reduction of 0·1 per cent. Si content; (2) a reduction of 0·1 per cent. total carbon, together with a reduction of 0·05 per cent. Si, and (3) a reduction of 0·2 per cent. total carbon." It is the Author's opinion that the research into this problem by the BCIRA may have been because of the difficulty being experienced in obtaining pig-iron with the necessary low-Mn content, and the fact that other founders were finding it difficult to produce a true whiteheart fracture and they were also troubled by the occurrence of mottle, which, however, was not encountered at Nacton foundry.

FIG. 8.—*Largest and smallest castings made at Nacton Foundry (compared with a matchbox); they weigh* 44 *lb. and* 1¼ *oz. respectively.*

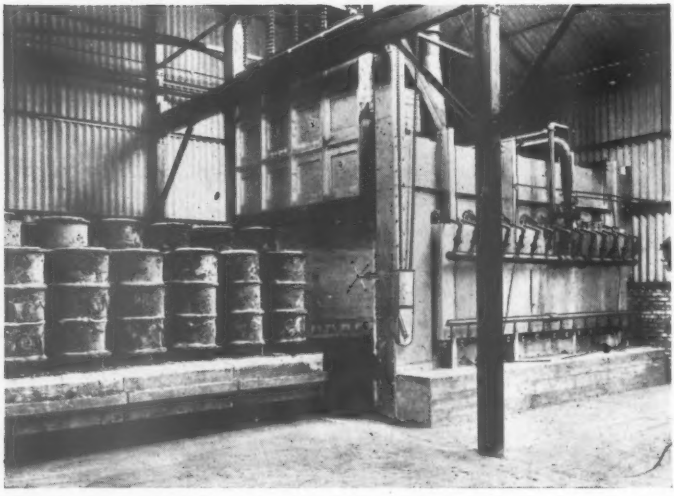


FIG. 9.—*Gas-fired bogie-hearth annealing oven of 10 tons capacity, loaded ready for lighting up.*

castings increased until it became necessary to melt metal for malleable on Saturday mornings. These runs were, of course, of longer duration than 1½ hours, and to provide sufficient demand for metal, every possible moulding machine was put to making moulds. Moulds were also ready for casting annealing pots, stools and lids. The Saturday-morning runs continued for some time and the beneficial result from the longer runs—which gave the cupola a chance to become stabilized—showed up immediately as an increase in the tensile strength of the metal annealed by an average of two tons per sq. in. When demand increased still further and week-day melts were recommenced, the results returned to the previous level—showing the benefit from specialization. This demand grew until the "pilot"—size annealing oven (previously described) was working non-stop. It was lighted on a Monday afternoon, to be unloaded and re-loaded the following Monday, week after week; yet this was still insufficient and so plans were made to increase the annealing capacity.

New Annealing Plant

Once again, oven designs were studied and manufacturers consulted; continuous plants, bogie hearths, orthodox tunnel-ovens, etc. were all considered. As it had been laid down that the new oven should have a nominal capacity of 10 tons of castings, a "top-hat" oven was out of the question due to the limited lifting capacity and head-room available. Town's gas firing and electronic control had served well and it was decided to keep to these. One other factor was decided to be an essential—the oven must be capable of the same performance and turnround as the original. This meant that the oven would have to be unloaded and re-charged within a period of eight hours. The equipment decided upon was a bogie-hearth type of oven and that installed can be seen (ready for lighting) in Fig. 10, which also shows part of the loaded hearth. The oven is 17 ft. 9 in. long, 9 ft. 3 in. wide and 6 ft. 3 in. high. As in the previous case, the construction is of mild steel with a lightweight refractory lining and with firebricks for the hearth and burner ports; there are 28 luminous-flame gas-burners.

Initial Difficulties

Unfortunately, the success which met the first annealing cycles in the lift-off type oven were not matched by the early experience with the second, and the troubles were very difficult to locate, mainly due to delay in diagnosis consequent upon belated machining. After the new oven had been running for about two months, however, complaints came in from the machine-shops about hard castings. The records of the various anneals were checked but no clue could be found there, so each pot of each oven-load had to be checked individually in new batches being treated. Hard castings were found in four pots of one batch, and the next difficulty was to locate these pots in the oven to see if trouble occurred at the same place each time. The markers of the oven said that any "cold" spots in the oven would be found by the door, but in the new checks instituted the hard castings were found in the last place expected—at the very back of the oven. Investigation showed that there was a considerable leak at the back seal of the furnace, and also that the hearth was not sitting "square" with the back wall of the oven. To overcome this trouble, an asbestos strip was fitted to the rear of the bogie hearth and another to the actual back-wall of the oven so that the two overlapped when the hearth was in position. To make really sure of the seal, the strip at the back of the oven was daubed with plastic refractory to make a positive seal.

Having cured the heat loss at the back of the oven, trouble was next encountered with the electronic controller. On the first oven which had been installed, apart from the initial trouble recounted, the controller had always proved reliable, but the new controller failed one night, resulting in overheating of the furnace above the 1,000 deg. C. limit, which caused some of the recuperator tubes to fail, and, in turn, after-burning took place in the recuperator chamber and sagging of the oven arch resulted. Also, the expansion joint in the arch was found to have been left unbridged and this led to further leaking and by-passing of the flues—the result being more hard castings. To remedy this, the rear portion of the oven roof had to be re-bricked and to prevent further overheating, the instrument manufacturers advised the installa-

tion of a second overriding controller set at a higher temperature than the first, and acting as a "policeman."

Furnaces Compared

The firm made a comparison of the lift-off oven and the bogie-hearth oven as follows: in both, the annealing cycle was the same; heating up to the soaking temperature of 980 deg. C. and soaking at that temperature took 110 hours. Naturally, the actual heating time varied according to the weight of the load, but the heat was always shut off after the same number of hours to allow 48 hours for cooling to 600 deg. C., at which temperature the ovens were opened. This allowed the period from 7.30 a.m. to 5.30 p.m. for cooling down to a temperature at which the load could be approached, when the hearths were unloaded and re-loaded, giving a complete cycle of one week. Every effort possible is made to arrange for the cooling period to be during the weekend, as this is the time when the ovens may be safely left to their own devices. Because the annealing cycle requires that the ovens are heated from cold each time, the walls should have low heat-storage capacity and the lightweight refractory has been used to ensure this. The areas of refractory in the two ovens are:—(*a*) *Portable-cover type:* 356.1 sq. ft. insulating refractory, plus 145.2 firebrick, giving a total of 501.3 sq. ft., and (*b*) *bogie-hearth type:* 486.3 insulating refractory plus 221.0 firebrick, giving a total of 707.3 sq. ft. The ratio of internal wall-area to load in the two ovens is therefore:—(*a*) 100.2 sq. ft., and (*b*) 70.7 sq. ft. per net ton respectively. This difference has, of course, a material effect on the gas consumption and added to that must be considered the better insulation possible on the bogie-hearth oven, where no weight-limit is imposed (further comparative data are recorded in Table II).

TABLE II.—*Comparative Operating Data for the Two Types of Annealing Furnace.*

	Portable-cover type.	Bogie-hearth type.
Working pressure—Gas	2 in. of water	3 in. of water
Air	5 ,, ,, ,,	6 ,, ,, ,,
Heating Up.		
Gas consumption to reach 980 deg. C.	79,500 cub. ft.	133,200 cub. ft.
Soaking.		
Gas consumption	87,200 cub. ft.	101,900 cub. ft.
Total consumption	166,700 cub. ft.	235,100 cub. ft.
Consumption per ton—Gross ..	9,260 cub. ft. or 41.67 therms	6,350 cub. ft. or 28.6 therms
Net	33,340 cub. ft. or 150.03 therms	23,025 cub. ft. or 104 therms

Packing and Unpacking of Annealing Pots

The development of the system of packing and unpacking the castings in and from the annealing pots was as follows:—With the small oven: the ore was mixed on the floor and the pots filled in the obvious way. For unpacking, the tiers of pots were put on the floor and individual pots picked up by a tong grab suspended from a small hoist. The pot was then knocked with a sledge-hammer so that the castings and ore fell on to the floor. Large castings were then picked up by hand (and put into a stillage) and smaller castings by a coke-fork—the ore and scale remaining on the floor. This ore and scale was then shovelled into a tipping hopper and taken into the foundry yard, where it was put through a builder's-type screen to remove the scale. (If this was done on a windy day, some of the dust was removed too.) By this method, it was possible for one man to pack and unpack the small oven in a week, doing the screening of ore on Saturday mornings.

When the second oven came into operation, the same system was followed, only two men were employed. With larger quantities of ore being handled, however, it was not long before the screen got overloaded and finally broken. The screening was then transferred to the foundry, where the screen was placed over a stillage and the castings were knocked out on to it. The ore (and dust) fell inside the stillage and the castings and scale remained on the screen and were picked off and put into a second stillage. The next development was to build a stand for the screen, under which the stillage could be placed, and with a pivot at one end so that the screen could be tilted. The pots were then knocked out as before, but instead of the castings being picked off, the screen was tilted and they fell into the stillage placed alongside. A "robot" knocking-out device for the pots is the firm's latest idea. It consists of a stand about 6-ft. high, the top of which carries the coarse-mesh

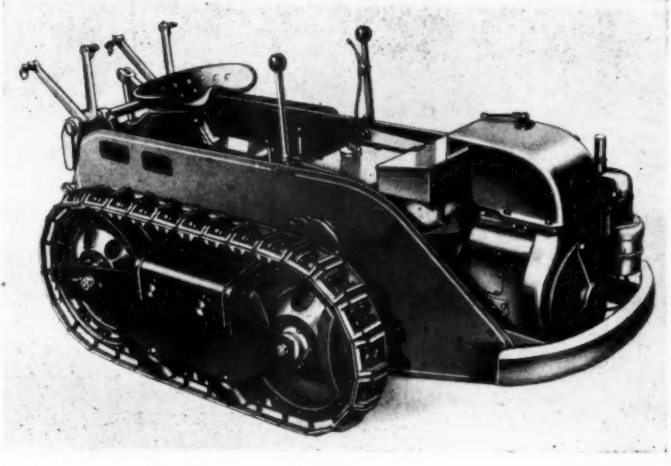
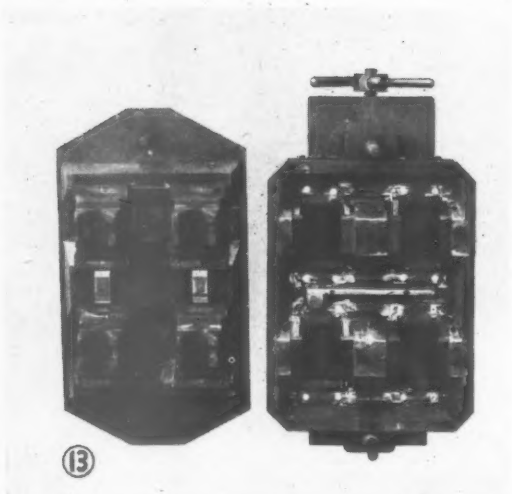


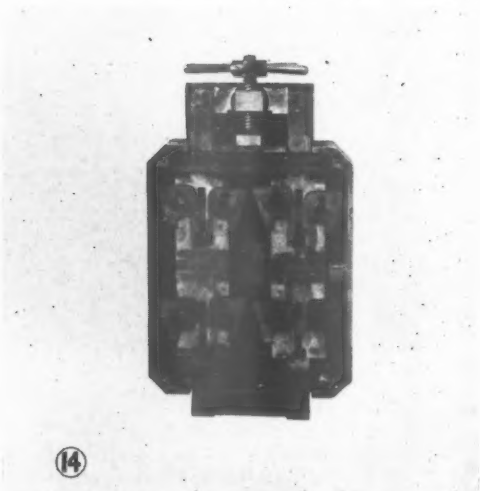
FIG. 10.—*Ransomes M.G. motor cultivator, the tracks of which consist each of* 32 *malleable links, now made at Nacton Foundry, as shown in Figs.* 11 *to* 14.

(11)

(12)



(13)



(14)

FIG. 11.—*Original pattern for M.G.-tractor link-casting, with its corebox. The large core required for this method of production is clearly indicated.*

FIG. 12.—*Experimental pattern boards for the track-link casting, showing the slides provided for making the treads and bolt-holes.*

FIG. 13.—*Production pattern for the M.G. track-link. The slides are withdrawn by rotating the capstan handle.*

FIG. 14.—*Underside of the production pattern for the M.G. track-link. Attached to the two slides are eight angle-pieces which locate in mating grooves in the pattern slideways.*

screen, hinged at one end. Below the first screen is a second screen of perforated steel-plate, which slopes towards the rear. This second screen is mounted on suspended arms so that it can be rocked back and forth. In the new system the pots are knocked out while suspended from the crane, on to the screen at the top, as before, the castings being retained on the screen and the ore and dust falling through to the perforated plate. The crane, with the pot still suspended, then engages under a large hook on the upper screen and tilts it forward so that the castings fall into a stillage. The perforated screen is then rocked, the dust or fines fall through the perforations in the steel plate into a stillage below and the ore slides along the slope into a third stillage. With this "robot" equipment, the packer with two assistants is able to serve the two ovens continuously, even though they are located on different sides of the foundry.

Further Development

An easier method of packing the pots was next devised and the following system is now adopted:—Two windows have been cut in the bottom of the

tipping hopper, each having a sliding shutter. Instead of bringing the ore into the foundry and mixing it with new ore on the floor, this is all done outside as the ore is loaded into the hopper. The pots being packed are so placed that they are the same distance apart, in pairs, as the windows in the hopper, and after the castings have been placed in the pots, the hopper is lifted off its stand by the crane and suspended over the pots. A circular frame about 4-in. deep is placed on each pot and the shutters opened, allowing the ore to run out until it fills the pots and the frames. The whole row, usually of eight pots, is dealt with in this manner and then each pot is rammed until the ore is packed firmly around the castings.

One example of the application and value of the firm's adoption of malleable founding can be related to the production of their MG model tractor or garden cultivator (Fig. 10). This is a quite small model running on tracks, each track being made up of 32 malleable links. These malleable castings were originally purchased from an outside supplier, but are now being manufactured at Nacton Foundry as follows:—The pattern and corebox (shown in Fig. 11) were first obtained and considered in relation to quantity production. In order to make the number required with the equipment shown, the resources of the firm's already overloaded coreshop would be taxed, and the wisdom of using such a comparatively large and expensive core for such a light casting was queried. First, the incorporation of loose pieces on the pattern to form the shape were considered, but these, it was felt, would be rather a nuisance for a quantity-production job. It was then thought that perhaps the shape of the tread of the shoe (which together with the bolt-holes was the reason for coring the centre), might be pressed into the mould after ramming. For this experiment a wooden pattern-board was made (Fig. 12); the pattern was then mounted on a squeeze machine and some moulds made, but the tread and holes would not press in cleanly. To obviate this trouble, a mould was next rammed with the slides in position and after ramming and before stripping, the slides were withdrawn. This method proved satisfactory and the result is shown in Fig. 13, with the operating mechanism shown in Fig. 14. It was thought obvious that such a delicate piece of patternmaking, working to such fine limits, would not long survive the rigours and rough handling in the foundry, so immediately one pattern was put into use, work was started on a second. However, this latter surmise was proved wrong, as in well over a year's working, with thousands of moulds made, the second pattern has never been put into use as a result of failure of the first.

Acknowledgments

The Author would like to record his thanks to the directors of Ransomes, Sims & Jefferies, Limited for permission to publish this Paper, to the photographic department and laboratory for providing the photographs and micrographs, and to the staff and personnel of Nacton Foundry who are responsible for the success which has been achieved.

Foundry Equipment and L & Y Holdings extend in America

Mr. A. S. Beech, chairman and managing director of Foundry Equipment and L & Y Holdings, Limited, and Mr. J. C. Howard, a director, have returned from a seven-weeks' business visit to the USA and Canada, during which they travelled about 16,000 miles. Whilst in Canada, they formed a new subsidiary company, F.E. (North America), Limited, for the purpose of handling the sales and servicing of the company's equipment and machines through agents in the States and to assist their existing agents in Canada with sales and technical service. The new subsidiary is located at 185, Eileen Avenue, Toronto 9, and has the following board of directors: Brigadier James Mess (president), Mr. A. S. Beech, Mr. J. C. Howard, and Mr. K. B. West; the three last named are directors of the parent company. Two remaining vacancies are to be filled by Canadians. The directors of the parent company expect that with their own group taking an active part in the promotion of business, they will greatly expand their Canadian trade and also develop their United States trade.

THE BOARD OF TRADE propose to revise the tolerances laid down in the Weights and Measures Regulations, 1907 (SR & O, 1907, No. 698), for weights in use for trade purposes. The proposals cover weights of the avoirdupois, grain, troy, apothecaries, metric and metric carat series. (Details from: The Controller, Standard Weights and Measures Department, Board of Trade, 26, Chapter Street, London, S.W.1.)

Birlec's Removal Offer

Because no more space is available for expansion in Birmingham, Birlec, Limited, industrial furnace builders, is moving to Aldridge, an "overspill town" for Birmingham, 10 miles away. The foundation stone of the new factory was laid last week, by Lord Chandos, chairman of the Associated Electrical Industries group, of which Birlec is a member.

It was announced that the company is to pay £100 to each of its 1,100 workers who agrees to move to Aldridge. In addition the firm will pay legal charges and the cost of removal to any employee wishing to buy a house near the new factory. The offers are meant as an incentive to employees to stay with the company, and to compensate for uprooting them from their homes in Birmingham.

Dinner

INSTITUTION OF PRODUCTION ENGINEERS

The Hon. the Earl of Halsbury, president of the Institution of Production Engineers, was in the chair for the annual dinner held last Friday at the Dorchester Hotel. The guest of honour was Sir John Maud, G.C.B., C.B.E., and he, and the chairman, were the only two speakers. As is customary at this function, the Institution's awards were presented. They were:—A presentation for the George Bray Memorial Lecture to Mr. Stafford Beer; for the Sir Alfred Herbert paper to Dr. B. V. Bowden; for the Viscount Nuffield paper to Dr. W. Grey Walter; the Lord Sempill paper to Mr. K. Frydag; and of the Schofield Travel Scholarship to Mr. H. Scholes.

Twelfth IBF Golf Meeting

A party of some 30 members and their wives this year met at Harlech for the annual competitions of the Golfing Society of the Institute of British Foundrymen. Unfortunately, the weather on the Saturday for the main events was atrocious, there being a constant rainfall during the whole period of the competitions. Members were fortunate, however, to see Harlech at its best on the Sunday morning when bright sunshine prevailed. The results of the various competitions are listed below:—

Saturday morning: Stroke competition for the IBF Handicap and Scratch Cup (22 competitors).

1. H. Oliver	..	94—18 = 76	Winner, Handicap Cup
2. P. G. Pennington	..	85— 8 = 77	
3. R. B. Templeton	..	92—15 = 77	Winner, Veteran Cup
4. J. Bell	..	92—15 = 77	
5. W. G. H. Woods	..	85— 7 = 78	
6. M. H. Hillman	..	81— 2 = 79	Winner, Scratch Cup
7. L. Mortlock	..	88— 9 = 79	
8. W. Jones	..	87— 8 = 79	
9. T. Reynolds	..	96—17 = 79	
10. C. H. Wilson	..	98—19 = 79	
11. Wm. E. Aske	..	98—19 = 79	

Mr. H. Oliver received the Handicap Cup, and also a tankard presented by the past-president of the Institute, Mr. H. J. V. Williams. The Scratch Cup was won by Mr. M. H. Hillman for the second year in succession, and he also received a tankard presented by Mr. H. J. V. Williams. The Veteran Cup winner was Mr. R. B. Templeton, and in addition to receiving the Veteran's Cup, also received a tankard presented by Mr. Wm. E. Aske. The branch Coronation Shield, presented some years ago by Mr. P. B. Higgins, was this year won by the Midlands branch, their team being represented by: Mr. M. H. Hillman 79, Mr. J. Bell 77, and Mr. E. W. Pugh, as reserve.

Saturday afternoon: Two-ball foursome and bogey.

1. R. B. Templeton and J. P. Wilson	.. .. ..	4 down
2. R. T. Turner and J. Bell	.. .. ..	5 down
3. P. G. Pennington and T. Reynolds	.. .. ..	6 down
4. H. Morton and J. H. Ainsbury	.. .. ..	6 down

The winners each received a chromium-plated "Lincoln Imp" kindly presented by the Lincolnshire branch of the Institute.

Sunday morning: Stableford fourballs.

1. R. C. Shepherd and W. Jones	.. .. ..	39 points
2. J. P. Wilson and G. W. Nicholls	.. .. ..	36 points
3. H. Oliver and T. Reynolds	.. .. ..	33 points
4. W. G. H. Woods and L. Mortlock	.. .. ..	31 points

The winners each received half-a-dozen golf balls as prizes.

LADIES' COMPETITIONS

Saturday

Unfortunately, due to the results of influenza and illness in families, the number of lady competitors was reduced this year to seven. The winner of the Coronation Rose Bowl was Mrs. H. Oliver with 21 points, other scores returned were:—

2. Mrs. W. Jones	20 points
3. Mrs. L. Mortlock	18 points
4. Mrs. T. Reynolds	17 points
5. Mrs. R. C. Shepherd	16 points
6. Mrs. H. J. V. Williams	15 points

In addition to holding the Bowl for one year the winner also received a "Lincoln Imp" presented by the Lincolnshire branch, and eight golf balls, the second prizewinner receiving four golf balls. All other lady competitors taking part in the competition were presented with a golf ball and a packet of tees.

Sunday morning: Stableford four-balls

The winner of this competition was Mrs. W. Jones (unpartnered) with 26 points, and the runners up were Mrs. R. C. Shepherd and Mrs. L. Mortlock with 25 points. All the ladies playing were presented with golf balls as prizes.

Annual General Meeting

In the absence of the president of the Society, Mr. F. A. Wilson, who was indisposed, the Chair was taken by Mr. R. C. Shepherd, vice-president, who in his opening remarks mentioned that letters of apology had been received from Mr. F. A. Wilson, past-president Mr. E. A. Phillips, and his son Mr. J. G. Phillips, also from Mr. P. B. Higgins, all of whom were absent due to illness. He then expressed his pleasure at the presence of the national president of the Institute of British Foundrymen, Mr. J. Blakiston, also the fact that the vice-president, Mr. H. J. V. Williams was present, and the junior vice-president Mr. C. H. Wilson, all of whom were accompanied by their ladies. He also expressed the Society's thanks to Mr. H. J. V. Williams and Mr. W. E. Aske for their prizes of tankards, and to Mr. E. A. Phillips and Mr. F. A. Wilson for their golf ball prizes.

After Mrs. J. Blakiston had presented the prizes, it was agreed by the meeting that Mr. F. A. Wilson should be re-elected as president for the ensuing year, and that Mr. R. S. Darby be invited to become a vice-president of the Society. The rest of the committee and vice-presidents were re-elected, and Mr. G. W. Nicholls agreed to continue with the post as secretary for a further year. After a lengthy discussion on the venue of next year's competition, it was decided that this should be played at Woodhall Spa, during the last week-end in September, and that in the meantime, the members of the committee give consideration to the venue for the 1959 competition. The meeting closed with a vote of thanks to Mrs. Blakiston for the presentation of the prizes.

Non-Ferrous Club

In outlining the difficulties which must be overcome before the inauguration of a European Free Trade Area became possible, Mr. R. Lewis Stubbs, O.B.E., who spoke to the Non-Ferrous Club at its monthly luncheon meeting in Birmingham, on October 2, drew attention to the importance of the commitments undertaken by the six signatory countries to the Rome Treaty which sets up the Common Market. He pointed out that both France and Italy were concerned about their own metal mining interests—France in Algeria and Morocco, and Italy in Sardinia—and if the Common Market agreements resulted in high tariffs for metals entering the Free Trade area, it would be extremely difficult for the other countries who were interested in setting up a Free Trade Area to negotiate. In the short view he thought the UK might be better outside the Free Trade Area although the advantages of cheaper metal might not ensue. In the long term view it seemed advisable to join in the scheme. The Common Market area involved 160,000,000 people, and if a Free Trade Area were set up it would represent an economic *bloc* equal to those of Russia and the United States. As a manufacturing country outside such a *bloc* and with receding dominion markets Britain might well find its position difficult.

At the luncheon the sum of £13 was collected on behalf of the Cancer Relief Fund. The speaker on November 6 will be the cricketer, Mr. Norman Yardley.

Mechanization for Shell Moulding*

Report of Progress in a South African Foundry

It can be stated that the development of the shell moulding process has fallen into three distinct phases: (*a*) The preliminary method of investing a pattern-plate on a dump box, and man-handling the plate or corebox to and from a separate oven; (*b*) the development of multi-station machines with built-in ovens, ejection mechanisms and pattern-plate handling devices controlled by an operator, and (*c*) the development of completely automatic moulding and coremaking machines where the operator simply removes the ejected shell half-mould or core.

Stage (*a*) of this development is over; stage (*b*) has been reached, in South Africa, and is being used extensively and the first machines of stage (*c*) are now making an appearance. Keeping pace with machine development have come improved resins and methods of mixing sand with resin binder; precoated sand is now an accepted material and is at present being introduced to South African foundries.

The original hand process utilized a gas or electrically heated oven as the plate heating and curing medium and although both forms of heating are utilized on machines, the tendency to-day is towards the use of electricity in one form or another. The principles of pneumatically-operated roll-over and radiant-tube elements involved in these machines are well known.

Fully automatic machines are now becoming available to South African founders, and one of their marked features is the wide use of electronic devices to eliminate the human factor. Plate or corebox temperatures, roll-over, investment times, curing cycles and ejection are all automatically controlled and extensive use is made of the built-in heating elements. Machines of this type, built in America, have reached outputs of 200 complete moulds per hour from mouldmakers and almost the same number of cores from coremakers. When one remembers that the mould areas are 54 by 27-in. and the corebox sizes 20 by 14 by 14-in., it can readily be appreciated that a very high daily tonnage of castings can be produced. A well-known car manufacturing company in Germany has recently installed a completely mechanized shell foundry where one operator produces a complete mould for an air-cooled cylinder every 10 sec., from an automatic machine.

Nearly all the new moulding machines have eliminated the investment bin and use a blowing principle, with an automatic suction mechanism to remove the surplus sand. The production of shells under a blowing pressure increases the strength and density and reduces the amount of resin required in the mixture (nearly all coremakers employ precoated sand).

Pattern Equipment

"A casting is never better than the pattern", this has always been the standby of the moulder and it applies equally well to shell-moulded castings. Much of the criticism about the accuracy possible from shell-moulded castings stems from the pattern equipment and, in general, too little attention has been paid to this point in South Africa.

It is well known that machined patterns and coreboxes are expensive items, particularly when these are made of cast-iron, steel or copper-base alloys; nevertheless, dimensionally accurate casting demands a machined pattern and corebox and sooner or later the founder must face up to the necessity of providing for them. Some foundries in the Union have already done this and the results obtained speak for themselves, others have yet to make a start. In one respect it is unfortunate that plaster-cast, patternplates are available from local patternshops, for the excellent finish and high standard obtained has led to the false belief that they are dimensionally accurate, which is certainly not always the case.

The best materials for patterns and coreboxes are fine-grain grey-iron, steel and certain of the copper-base alloys, since these are capable of taking a high finish, are hard and strong, or have good heat characteristics. With the development of mechanized or semi-mechanized methods of shell moulding, where the need to manhandle patternplates and coreboxes is eliminated, the use of these materials for pattern equipment has become almost universal.

The heat lost from the surface of the pattern and patternplate to the sand/resin mixture on investment is replaced by heat transferring through them and it is important that the heat conductivity of the metal employed should be sufficiently high to allow the surface temperature to return to the optimum, during the curing stage. The material selected for patterns or corebox is dependent to an extent on this property and consideration should be given to this point before the patterns are made.

If the casting has thin sections, standing up from the body, it is preferable to use a copper-base alloy with high thermal conductivity, *e.g.*, an air-cooled cylinder pattern. This point is borne out by a shell taken from a plate having two identical patterns, with thin flanges around the edges, one pattern being in cast-iron and the other in a copper-base alloy—the investment over the flange of the latter is much thicker than the former. The surface finish of pattern equipment is very important; the finer the finish the less pressure is required to eject the shell and from this point of view the surface

* Abstract from a paper presented by Mr. Coombs to the South African branch of the Institute of British Foundrymen, and published in *Engineer and Foundrymen*. The Paper was illustrated by means of a short film.

obtained on plaster-cast pattern equipment is excellent. A very-fine-machined or ground finish is also ideal for ejection.

The positioning of ejector pins on the patternplate is often the responsibility of the patternshop and, providing care is taken to achieve an even distribution over the plate and placing them next to points of long draw, there is rarely any fault to find. A tendency to use an insufficient number of pins is noticeable, particularly around or through the patterns; this can cause slight buckling and, in certain cases, cracking of the shell. Taken by and large, the major cause of ejection trouble is undercuts on the pattern and an experienced operator will quickly spot these from the appearance of the mould cavity in the shell. Aluminium patterns show a grey streak on the shell at the point of the undercut, due to the shell material cutting away a film of aluminium as it is ejected. There is a strong possibility that in the future epoxy-resins will be used for shell moulding and further information of this most useful development is expected within the next six to 12 months.

Moulding Material

Silica sands used for shell moulding must be free from clay, alkalis and organic material and should preferably have a rounded grain shape. The sieve number used varies considerably with the type of casting being made; aluminium castings give very good surface finish with a sand of 150 mesh, while a heavier grey-iron casting gives an equal surface finish with a lower mesh size. In general, it can be said that fine sands are used for non-ferrous metals and a mixture of fine and coarse sands for ferrous alloys.

For any given resin content increasing mesh gives decreasing shell strengths for a given thickness of shell and it therefore follows that the finer the sand used, the more resin is required. Where heavy iron castings are being made, weighing, say, 30 to 100 lb., a mixture of 25 per cent. coarse sand and 75 per cent. fine gives good mould strength at 5 per cent. resin, light iron castings made in a finer sand may require 6.5 to 7 per cent. to obtain equal strengths. The amount of resin required will also vary with the pouring temperature of the metal and its freezing range; where temperatures are high and the freezing range long, the rate of breakdown of the shell is rapid whilst the metal in the mould remains liquid for a long period and it is then necessary to use a higher resin content or a thicker shell. The average shell moulding being carried out in South Africa uses 6 to 7 per cent. resin and shell thickness of $\frac{1}{8}$-in. These remarks on silica sand apply to the conventional powder-resin/silica-sand mixture only, precoated sands will be described later.

Resin Binder

Many different types of resin have been advocated for shell moulding, but phenol formaldehyde resin with 10 per cent. hexamine is still the most widely used, due to the fact that its breakdown temperature is higher than all others. As a comparison, urea formaldehyde resin breaks down at 220 to 270 deg. C. and phenol formaldehyde at 400 to 450 deg. C. It should be remembered that any type of resin is capable of producing an almost infinite number of resins having different physical and chemical properties and this has led to the production of a range of shell-moulding resins, in the one resin group, for different requirements. Thus, phenol formaldehyde resins are available with short, medium and fast curing cycles, slow or fast investment times, high and low melting points, short or long flow, etc., from which it will be appreciated that it is difficult to obtain any one resin which satisfies every foundry need. The fact that grey-iron castings weighing from $1\frac{1}{4}$ ozs. to 120 lb. have been produced in quantity suggests that the quality of South African resin equals those produced overseas.

Unfortunately, phenol formaldehyde is a synthetic chemical derived by processing from synthetic raw materials and it is unlikely that the price will be reduced yet further than it is at the moment; indeed, the tendency in America during the last two years has been to increase slightly. This has been responsible for a world-wide search for cheaper binders and many thousands of synthetic and natural materials have been examined with this aim in view. It is believed that there may well be cheaper materials having better properties than phenol formaldehyde resin but time alone will prove the contention.

Stripping Agents

Only two materials have found wide acceptance as release agents for shell moulding, these being silicones and wax/oil emulsions. Both are used in a concentrated and diluted form for conditioning new plates and coreboxes and spraying between cycles respectively. Silicones have found widespread acceptance in America and wax/oil emulsions in Europe and South Africa, although there has been a tendency in recent months for large, mechanized, shell-moulding foundries in America to change over to wax solutions. Both types worked satisfactorily with the wax/oil emulsions giving a slightly easier mould strip and a considerably reduced conditioning time; silicones, however, give slightly less build-up on the patternplate and are less likely to affect the surface hardness of the shell when applied excessively. Neither can be considered to be foolproof and much work is being carried out to improve the position.

The introduction of precoated sand has reduced the necessity for stripping agents and research continues to find means of incorporating these compounds into both precoated sand and the conventional sand and powdered resin mixture. At the time of writing, precoated sands are made with the stripping agents incorporated during the preparation. A synthetic wax has been developed in America, which can be added in powder form to the conventional mixture thereby eliminating the need for spraying between cycles. The writer has made 20 precoated-sand cores from a newly

machined corebox without applying stripping agent at any time. It is quite safe to forecast that within 12 to 18 months the separate application of stripping agent between cycles will be a thing of the past.

Running, Feeding, and Pouring

The subject of running, feeding and pouring is one which would make a full paper in itself and it is only possible to touch on this subject briefly. Experience has proved that the techniques applying to green-sand moulded castings cannot be used in shell moulding and a completely new approach to the subject is required. The first major point of difference between the two moulding methods lies in the degree of friction encountered by the metal in the runners; in a green-sand mould the friction of the sand is high and the metal stream rapidly loses its kinetic energy as it approaches the ingates while in a shell mould the smooth surface finish, fine grain size sand and the absence of moisture reduces friction to a minimum. Furthermore, in a green-sand mould, the metal in the runner first freezes on the wall of the green sand and metal then flows through a solidified sleeve which only remelts slowly as more metal passes through; in a shell mould the extent of the freezing is much reduced due to the absence of moisture, and the solidified sleeve rapidly remelts, assisted by the exothermic reaction of the burning shell material. For a given runner system the velocity of the metal stream is very much greater in a shell mould than in one of green sand.

In green-sand moulds the runner system is usually designed to choke from the ingate, and the ratio of the areas of the downgate, runner bar, and ingates is usually one of progressive reduction. In a shell mould, however, such a system would produce a jet action to the metal at the ingates which in turn would have a scouring action on some part of the mould cavity. The procedure usually adopted is to choke away from the ingates and allow for quiet filling of the mould cavity with a minimum degree of turbulence. The ingates must be positioned where the incoming metal stream will not flow against protrusions such as cores, re-entrant angles or nearby casting walls, etc., and for preference in the lower part of the cavity.

The degree of feeding required is often a function of the tolerances required in the casting and, contrary to much of the early published information, it is often found that close tolerances are only achieved by means of gross overfeeding, this being particularly true for horizontally-poured, grey-iron castings. Running feeders are usually employed and the atmospheric feeder has found widespread application in both horizontal and vertical casting.

Slag traps are very important as the lack of friction in the runner system readily allows small dirt and slag inclusions to pass through into the mould. They are usually placed before the choke and often form part of the choke itself. The well-known principle of a sudden reduction in runner bar to give a slag trap is used and the equally well-known saw-tooth runner-bar with a progressively reducing area is also very effective.

Runner cups are occasionally used to control the degree of overflow after pouring but, as the moulding of these is a separate operation, most foundries prefer to use a wide downgate to eliminate this need. Vertically-poured moulds are invariably made with built-in runner cups. One enterprising company in South Africa developed an ingenious method of moulding a runner cup integrally with the shell for horizontal pouring but unfortunately it was impossible to incorporate the same principle when the change was made from hand process to a semi-mechanized machine.

Pouring is usually carried out on a green-sand bed without the need for additional mould support when horizontally cast. Moulds for heavy castings are sometimes bedded into green sand to the joint-line and a layer of green sand placed on the cape to exclude air and reduce the extent of mould breakdown after pouring. Vertically-poured moulds are usually embedded in green sand, metal shot rarely being used as a supporting medium in South Africa.

In recent years much experimental work has been carried out to develop stack moulding and progress has been made in England and Germany along these lines. It is expected that this method will find increasing application as time goes by.

Precoated Sand

Since the inception of shell moulding, it has been appreciated that the mixing of a dry sand with powdered resin is both inefficient and wasteful and development work was being carried out as long ago as 1946 to coat sand grains with a film of resin. To-day, several different methods of precoating are in use, falling broadly into two different methods, namely, hot process and cold process. The hot process was the first to be used and consisted, briefly, of heating the sand and resin mixture to slightly above the melting point of the resin and cooling down with constant agitation. The method required extensive plant and results were not always consistent. It was often found that on travelling from the manufacturer to the customer, the resin was chipped from the sand grains and collected in the bottom of the container. Few foundries were prepared to instal the expensive equipment and the method has now been largely superseded by the cold process which can be carried out with relatively inexpensive equipment in the user's foundry.

In the cold process, dry silica sand is charged into a sand mill and a solution of resin in a volatile organic solvent slowly added. After milling for one or two minutes, powdered hexamine is added and milling continued until all the solvent has evaporated. The evaporation is usually speeded up by playing a warm air blast on to the sand. When evaporation has been completed the precoated sand is again free flowing and is ready for use, after sieving to remove any lumps.

Precoated sand requires approximately half the resin content of the powder mixture and has many

other advantages apart from cost. It is likely to eventually replace the powder mixture. The introduction of precoated sand has led to a reassessment of the type of sand required, recent work indicating that the presence of a small quantity of natural clay gives improved hot strength and markedly affects the finish obtained on mild-steel castings. The grain shape now recommended is round to sub-angular and this has shown improvements in both the hot and cold strengths of the casting.

Tolerances

Early claims to the accuracy of shell-moulded castings have done more harm to the process than any other factor and designers and engineers have been disappointed with the results obtained. It has been proved that tolerances of plus or minus 0.002-in. per inch are possible and have been achieved in South Africa but it must not be assumed that the figure holds good for any one dimension of a casting. The possible accuracy depends on a number of factors such as the quality of the pattern equipment, degree of feeding, consistency of metal composition and pouring temperature and, not least of all, the position of the dimension in question in relation to the jointline. The closest tolerances are obtained in cored sections followed by portions fully contained in one half of the mould. Wider tolerances are required where dimensions are taken over the jointline and the following figures are a general guide to what is being obtained in practice:

Cored sections, 0.001 to 0.003-in. per inch; in one half mould, 0.002 to 0.004-in. per inch, and across jointline, 0.002 to 0.006-in. per inch.

The accuracy obtained across the jointline depends on the method of closing the moulds—bolting still remains the most accurate method—figures will shortly be available for hot-set adhesive. The figures quoted must be taken as a general guide only, in some cases they have been improved upon and in others the reverse is the case. The writer has no wish to play down the importance of close tolerances but other advantages inherent to the process receive less consideration than they deserve. This is the fault of the original supporters of the process, who oversold accuracy and undersold a most useful foundry-production method.

Unsolved Problems

In common with all other processes, shell moulding still has its problems and it would not be out of place to mention a few in a Paper of this type. Mild-steel castings have not yet been produced with the high surface finish obtainable from other metals and the straight copper-zinc alloys, particularly 60-40 brass, have given disappointing finishes with silica sand and resin mixtures. A variety of reasons have been put forward, for the poor finish of mild steel, of which the effect of strong reducing gases on molten steel is a popular one. Various additions to the sand mixture such as zircon flour, iron oxide, manganese dioxide alone or with lead oxide, plumbago, etc., have been suggested. The first of these has had a pronounced effect on 60-40 brass. It has not been easy to produce pressure-tight 60-40 brass castings in thin sections but bronzes and gunmetals have given excellent results. Grey-iron castings have, in a few cases, been very prone to an "orange-peel" defect on the surface which has only been overcome by heavy feeding or changing from horizontal to vertical pouring.

Mould cracking occurs from time to time resulting from mould expansion on pouring. Unfortunately, the coefficient of thermal expansion of a shell has been found to increase with increasing cure temperature and this factor has been a deterrent to decreases in overall cycles by means of higher plate and curing temperature. Research indicates that certain additions to the mixture may well overcome the problem but work on this subject is not yet completed.

DISCUSSION

Following presentation of the Paper at the IBF meeting, MR. G. F. ALEXANDER, who was in the chair, called on Mr. S. Cheetham to make a contribution.

MR. CHEETHAM, who had recently relinquished the control of a shell-moulding foundry overseas, congratulated Mr. Coombs on his paper and film, and commented on production problems. Regarding release mediums used to stop the shell adhering to the pattern, he pointed out that "No-Reseasil" could stop the build-up of sediment on the pattern-plate. He quoted the case of a 0.002 to 0.003-in. build up on each face of a five-wheel gear train to illustrate the prime importance of pattern cleanliness, which could only be achieved by scraping.

Overcoming Mould-temperature Difference

Confirming that half the mould being hot whilst the other half was cold presented a problem in the use of adhesives and caused distortion, Mr. Cheetham related that one method which he had used to overcome this problem was to glue two cold halves together, pin them with bent foundry brads and run them through a gas-fired tunnel oven on a conveyor, when, on emerging, the brads were knocked off and the shells were ready for casting. This reduced production, but as in his case shells were produced in larger quantities than the rate of casting, no hold-up ensued.

MR. COOMBS related that he had found that some of the finest cores obtained had been from pre-coated sand; he felt that far too much emphasis was placed on fine-grain sand for shell moulding. Regarding the build-up on pattern-plates, he had not mentioned this in his paper as it had always been a big problem, especially with wax-oil solutions. There was no straightforward method for removal: aluminium was the main "bugbear" as sand blasting could not be carried out because the accuracy of the patterns would be lost; this could only be overcome by incorporating

a stripping agent in the sand itself. For patterns other than of aluminium the build-up from wax-oil solutions could be removed by heating the pattern-plate for about 30 minutes in 10/15 per cent. sodium metaphosphate solution up to 160 deg. F., which loosened the carbon build-up.

Bonding-resin Melting with Large Castings

MR. G. F. ALEXANDER asked about the disintegration of shells, due to the action of heat on the bonding resin, particularly in the case of a large quantity of metal.

MR. COOMBS replied that the question of the amount of metal which could be put into a mould remained one of the greatest disadvantages of the process. The first reaction on the metal being poured into the mould, was to start burning out the bonding resin from the face of the shield; this could be overcome by covering the mould with green sand, which excluded air from the face of the shell and thus maintained its strength on the outside. The green sand had to be pressed down properly to ensure efficient air-exclusion. If only it were possible to exclude air during pouring, the mould would have much greater resistance to temperature and pressure. In Germany and particularly in America there had been a tendency to back-up in shot, but to-day's trend was to pour the mould unsupported. Last year one foundry in America produced 60,000 tons of castings and had recently started producing crankshafts by unsupported pouring.

High Production and Precision

MR. H. ESTLER said that, from the film shown, it appeared that the shell-moulding process was more suitable for the mass production of castings and he felt that its application in South Africa was very limited. The number of castings in any particular series was never so much as required overseas in highly-developed countries.

MR. COOMBS referred to machines which produced 20 to 25 complete moulds per hour and that such machines were used in South Africa. He added that he knew of one or two foundries in this country which could use mass production. Shell moulding was not limited to long runs. His firm found they could produce patternplates for shell moulding which were not much more expensive than for green-sand moulding but added that one could not expect to get a dimensionally-identical casting from a number of cast patterns of different dimensions. He stressed the importance of a dimensionally-identical casting and said this was where shell moulding came into its own. He added that he knew of one foundry which had run 50 only off in shell moulding because it was the only way of making a particular casting.

Film about a Cannon

The film, "The Pride and the Passion," released by United Artists, is believed to be the first in the history of the motion-picture industry in which a casting is featured as the "star character." The film is set in the period of the Spanish War of Independence in 1810, and the plot deals with the haulage across difficult terrain, and eventual use of a 2¼-ton cast-brass cannon. For the production of the film, six cannon were cast, one in brass and the remainder in aluminium alloy. The reason for this is stated to be that in certain incidents the cannon must be of considerable weight, for realism, whilst in others lightness of weight facilitated safe handling of the piece. Each of the cannon is 25-ft. long and is mounted on a carriage having 10-ft. dia. wheels; the outer designs, comprising scrolls, handles, carved figures and inscriptions are all claimed to be accurate reproductions of those found on field-pieces of the period. During the actual "shooting" of the production, some 200 men were employed to strip, move and reassemble the guns as required; this resulted from the film director's estimate that film crews could move more rapidly from scene to scene than the guns. Thus the photographers, on reaching a new location, were able to start production without the considerably expensive delays that might have occurred.

United Artists' release of the film "The Pride and the Passion" features a cast cannon used during the Spanish War of Independence of 1810. *The picture shows one of the final scenes from the film, where the cannon is firing at the walled city of Avila.*

Notes from the Branches

East Anglian Section

The East Anglian section of the London branch of the Institute of British Foundrymen opened their 1957-8 session on Thursday, September 26, with the annual works visit. Once again, the function was favoured with excellent weather; this year the hosts were Laurence Scott & Electromotors, Limited, of Norwich. The party of approximately 35 included the London branch president, Mr. A. Talbot, and the branch secretary, Mr. A. R. Parkes.

The first part of the visit was round the main Gothic Works, where the visitors were shown the patternshop, the machine, fitting, and assembly shops, where electric motors of all kinds were in the process of manufacture. The guides of the four parties took great pains to explain the work which is being carried out, and it was especially interesting to note the use being made of spheroidal-graphite iron in the products.

Refreshments were kindly provided by the company during the interval in the afternoon, and Mr. Berry, the section president, took the opportunity to thank the directors of Laurence Scott for their hospitality, making special reference to the trouble being taken by the guides to make the visit so interesting. After the break the parties moved to the foundry where they stayed the rest of the afternoon enjoying themselves as foundrymen will in another foundry.

Joint Meeting in Norwich

In the evening a meeting was held in the Norwich City College where the section was joined by a considerable representation of the Norwich Engineering Society with their president, Mr. Maddison, and the Norwich section of the Institution of Production Engineers, the chair at this meeting being taken by the section president, Mr. R. E. Berry. Mr. Berry first introduced the London branch president, Mr. Talbot, and remarked that Mr. Talbot should really be in the chair, as Mr. Berry's induction had not yet taken place, but as Mr. Talbot had held a full meeting of his branch the evening before he had asked Mr. Berry to preside.

The speaker, Mr. Braidwood of the Mond Nickel Company, Limited, was next introduced and he presented a paper on "S.-G. Iron—An Engineering Metal," which was illustrated by a sound film and slides. Mr. Braidwood had previously delivered a similar paper at other gatherings of the Institute, but his remarks "broke new ground" for the engineers and many local foundrymen present. An interesting discussion followed the paper, during which Mr. Braidwood adequately answered questions from foundrymen and engineers alike. A vote of thanks to the speaker was proposed by Mr. Maddison and suitably seconded by Mr. Crowther from the visiting societies, these being passed with acclamation.

Mr. G. J. W. TURNER, High Sheriff of Warwickshire, on October 1 performed the opening ceremony of the new permanent headquarters of the Midland branch of the Institute of Directors at Britannia House, Great Charles Street, Birmingham. Among those present were Sir Richard Powell, director-general of the Institute, and Mr. Guy M. Chantrey, branch chairman. Mr. Chantrey said that when the branch was inaugurated eight years ago, membership was 67; the present membership is 2,600. The branch is the first to acquire a headquarters of its own.

ECSC Economic Expansion Slackens

The rate of economic expansion in the European Coal and Steel Community countries is slackening. Speaking in Luxembourg recently, the vice-president of the ECSC High Authority, Mr. Albert Coppé, said that although there was a falling off in expansion it still remained good. Demand for steel was still firm despite a fall in orders from non-member countries.

Output of pig-iron and crude steel was still making rapid headway, but "the rate of increase for pig-iron is still lower than that for steel, and that is disturbing the balance of the Community's scrap supply," said Mr. Coppé. Scrap imports in the first eight months of this year were nearly 21 per cent. higher than in the January-August period of 1956.

"This development is causing much concern, particularly in the light of the Community's aim of reducing total scrap imports to 1,500,000 to 2,000,000 *tonnes* a year by 1960. During the first eight months of 1957 we were importing at an annual rate of 4,000,000 *tonnes*," he said.

The results of the 1957 inquiry into investments showed that in 1960 the effective production possibilities for pig-iron and steel would be 0.764 *tonnes* of pig-iron per *tonne* of steel, instead of 0.781 *tonnes* as envisaged in the Community's general objectives. In order to implement the general objectives, the investment effort in pig-iron production must be steadily stepped up.

Safety in the Iron and Steel Industry

Promotion of safety in the iron and steel industry and conditions of work and social problems in the industry in countries in the course of industrialization are two of the subjects to be considered by the sixth session of the iron and steel committee of the International Labour Organization which opened in Monterrey, Mexico, on October 7. The committee will also consider the general report, in particular the action taken in the various countries in the light of the conclusions adopted at previous sessions of the committee, the steps taken to follow-up the studies and enquiries proposed by the committee, and recent events and developments in the iron and steel industry.

The United Kingdom Government is represented by Mr. H. F. B. Fane, O.B.E., Principal, Ministry of Labour and National Service, and Mr. C. A. Bryer, M.B.E., Labour Attaché, British Embassy, Mexico City. The employers' representatives are Mr. R. Mather, chairman, Skinningrove Iron Company, Limited, and Sir Geoffrey Summers, BT., C.B.E., D.L., J.P., director, John Summers & Sons, Limited, who is accompanied by three advisers, Mr. D. Bruce-Gardner, director and joint general manager, John Lysaght's Scunthorpe Works, Limited, Mr. J. Ross, director, Iron and Steel Trades Employers' Association, and Mr. A. W. W. Watson, head of the labour and training department, British Iron and Steel Federation. The workers' representatives are Mr. J. O'Hagan, member of the Trades Union Congress General Council and general secretary of the National Union of Blastfurnacemen, Ore Miners, Coke Workers and Kindred Trades, and Mr. D. H. Davies, assistant general secretary of the Iron and Steel Trades Confederation.

A NEW colour-change floodlighting system for Niagara Falls is to be supplied by the General Electric Company, Limited, which has been awarded the $155,000 contract through its Canadian associate.

A Foundry "Convention"

Enterprising Venture at John Harper & Company, Limited

Returning from a convention held at the Albion Works of John Harper & Company, Limited, of Willenhall, the question arises as to what title to give it to signify just what form the meeting took. The expression "sales convention" usually indicates a gathering of the agents and representatives of a firm to learn about new products and general development. Harper's function, however, was what we believe to be a new type of convention which is in being in the United States. It consisted of an assembly of the firm's large customers (about 50), who first listened to an address given by Mr. Wilfred Harper, the managing director, on the history, the present structure and the future developments of the company. This was followed by talks from various prominent members of the staff, who covered various phases of the firm's activities. After luncheon, the guests visited an appropriate cross-section of the works. Finally, over a break for tea, opportunity was given for questions. Thus perhaps, "customer convention" is the title best suited to the occasion.

Origin and History

Mr. Harper, in his address, told his audience that the firm was founded by his great- great-great-grandfather in 1790, to manufacture latches, locks and keys. It was made into a limited company in 1888 and had paid a dividend every year since then, with only two exceptions. It was formed into a public company in 1930 since when the dividend had increased steadily from 7½ to 30 per cent.; this 30 per cent. dividend had been paid each year for the last ten years. One quarter of the firm's authorized share capital of £400,000 is issued and held by employees as Employee Preference Shares. This scheme was launched in 1926 and has always proved a very pronounced stabilizing influence on the employees. "It can truthfully be said that labour relations in this firm are as good as those in any company that we know," said Mr. Harper. Examples of this are shown in the fact that there are many instances of the second, third, and even up to the fifth generation of a family working for the company, the long-service Roll of Honour (exhibited in the front office) shows that once a person comes to the works, they tend to stay there until retirement. The directors are now of the opinion that the Employee Preference Shares are rather outliving their usefulness and are preparing a new form of profit-sharing for employees.

Foundries

The company is divided into three separate divisions namely, grey-iron foundry, Meehanite foundry and finished-goods department. The grey-iron foundry came into existence with the foundation of the company, in order to supply castings for keys, and later on, the ornamental castings required for hanging lamps, etc.

Some examples of this early decorative ironwork were on show in the hall. The foundry soon grew too large for its output to be entirely absorbed by the finishing departments of the firm and the sale of castings direct to engineering firms was started. Nowadays, the company produces about 150 tons per week of castings for the engineering industry, ranging from typewriter to tractor components, and the emphasis has always been on high-quality and a fine skin finish. The policy has always been directed towards keeping the cross-section of work undertaken as wide as possible, and although since the war a certain amount of mechanization has been carried out, the foundry is still essentially a jobbing foundry. Emphasis on increased efficiency has always been directed through improved methods, work-study, and closer control at all stages.

Meehanite is a comparatively new type of cast iron, in that it only came into being the early part of this century. The main advantages compared with grey iron are that it gives improved resistance to shock, pressure and abrasion, in other words it can be used for a variety of engineering purposes that require a better metal than ordinary grey iron. Harper's Meehanite foundry produces approximately 75 tons of castings per week, ranging from a few ounces up to nearly 2 tons in weight. One of the most striking examples of the use of Meehanite iron at this firm is in the production of cast-to-form dies. All the dies used in the firms' own press shop are made in Meehanite—a striking example of confidence in the material.

Finished-goods Department

This department, which started by making locks and latches, first began to make oil stoves in the early 1880's and the "Beatrice" heater, which is one of the firm's most famous products, was originally developed for the company by the late C. R. Retallack. This heater really started the firm in the oil business and, to date, nearly 750,000 of the current model have been produced. In addition to oil heaters, the department makes oil stoves, gas appliances, and hardware such as domestic scales, food mincers, corn mills, coffee mills and door furniture. There is a regular weekly production of 28 different articles, totalling last year over three-quarters of a million units, and "finished goods" were exported to no fewer than 53 foreign countries.

Future Developments

In all sections of the output, the firm is constantly meeting keen competition. There is, therefore, no fear of complacency, monopolies, or restrictive

A Foundry "Convention"

practices, and research is being continuously carried out into new materials and new methods. One example of new materials is the ductile iron, the production of which the firm is developing in conjunction with the Mond Nickel Company, Limited. Examples of new methods are the use of a hot-blast, water-cooled cupola, coil-feed presses and the flow-line production of oil convector heaters. The design of the finished products is claimed to be second to none in the country and by continuous laboratory testing both in the foundries and in the finished-goods department, constant endeavour is made to maintain and improve standards. For example, a household scale of new design was tested in a specially-designed machine to yield information to the equivalent effect of 50 years of weighing; no deterioration of accuracy was found.

Exhibition

There was a harmonious collection of "old" and "new" items in an exhibition staged by Harpers at the back of the hall in which the "customer convention" was held. An exhibit which the writer appreciated most was a black-and-white enamelled snuff-box, bearing the caption "a present from Iron Bridge," and carrying a picture of this famous cast-iron structure. The very ornate examples of early-Victorian decorative castings would certainly embellish a white-washed cottage home. It was when they were used in excessive quantity that the artistic quality was so much lowered. The exhibition of modern streamlined goods and highly complicated castings were in marked contrast with the earliest productions of the works.

Works Tour

A favourable impression the writer gained through a tour of the works was conveyed *inter alia*, by the intensive use that is made of lift trucks and stillages, the orderliness and cleanliness of the shops, and the intelligent use of overseas labour—amongst whom there were many West Indians, Poles, Italians, Indians and Pakistanis. There has been no slackening up in the control of the production of Meehanite metal and the continuous testing of each tap of metal from the furnace is carried out with the same regularity as the day the system was first installed.

[In order to help those readers who deem a "customer convention" to be worth taking up as a means to propagate sales, the titles of the papers delivered and the names of the authors are listed, *viz:* "Industrial Finishes," by Mr. C. V. Matthews (works manager, finished-goods department); "Developments in the Use of Cast Irons," by Mr. L. Clarke (technical manager); "Developments in Oil-heater Design," by Mr. D. H. Middleton (development manager); and "Developments in Foundry Methods," by Mr. F. Gaiger (foundry superintendent). Each speaker told something of the methods used and stressed what was done for the benefit of the customer.]

Britain's Biggest Arc Furnace?

Lord Chandos, chairman of Associated Electrical Industries, Limited, switched on the power to what is claimed to be Britain's largest electric-arc furnace at the Stocksbridge works of Samuel Fox & Company, Limited, on October 3. The 20-ft. hearth diameter furnace, which will produce 80 tons of steel per charge, will provide between 1,400 and 1,600 tons of alloy and stainless steels each week for the country's expanding motor-vehicle, civil-aircraft, steam-generation plant and chemical-plant industries. It will boost special steel output at the Stocksbridge works from the present 300,000-ton level to nearly 400,000 tons annually.

It is almost exactly three years since Samuel Fox commissioned a 19-ft. hearth diameter arc furnace, which was then the largest in Europe. The new furnace, like its predecessor, was built by Birlec, Limited, and is a top-charged, direct-arc unit with three 20-in. dia. electrodes. The stainless-steel shell base of the furnace can accommodate an induction stirrer similar to the one fitted on the earlier furnace.

Progress Towards Clean Air

Although the problem of air pollution dates back at least to the 18th century, it is not until the post-war years that the public conscience has been stirred to any marked degree. Dr. R. Lessing, the new president of the National Smoke Abatement Society, said in his presidential address at the annual conference recently, that he had been associated with the work of the Society and of its two predecessors, the Coal Smoke Abatement Society and the Smoke Abatement League, well before the first world war, but it is only in recent years that the Society's work has been able to claim the wide public merit it deserves. Dr. Lessing was making no overstatement when he said that by its discussions, publications, advice and services, and by peaceful persuasion of authorities and individuals, the Society could justly claim to have prepared for effective working of the new legislation of the Clean Air Act.

The Society is to change its name—to the National Society for Clean Air—and to make application for incorporation. Thus, said Dr. Lessing, its status would be enhanced and the more comprehensive title would widen its scope and set new tasks.

"Press-button" Future

Ten years from now the most striking change might be in the new work done by automation—and not so much in the automation of clerical work. This was one aspect of the future of automation envisaged by Mr. Alan Kenyon, of Guest Keen & Nettlefolds, Limited. He was speaking at the summer school of the Institute of Cost and Works Accountants at Cambridge. Present developments, he said, showed a major breakthrough towards the goal of the automatic factory and as the goal drew nearer there might be three shifts working with one maintenance shift.

An interesting possibility foreseen by Mr. Kenyon was "units" of automotive equipment of relatively simple design. These would be capable of flexible arrangement—rather on the lines of unit furniture which could be built up in sections and rearranged according to requirements.

The reason why the fully automatic factory was unlikely to be seen for a long time was, he believed, not so much because of the technical difficulties, but rather that, beyond a certain point, additional capital invested would not yield a satisfactory return.

Company News

BRIGHTSIDE ENGINEERING COMPANY (IRELAND), LIMITED—Net profit for the year to June 30, 1957, is £5,318 (£6,264); the dividend is 10 (12½) per cent.

HOFFMANN MANUFACTURING COMPANY, LIMITED—The interim dividend is being raised from 2½ per cent. to 3½ per cent., tax free, for 1957. The 1956 final was 10 per cent., making 12½ per cent., tax free.

GLOUCESTER RAILWAY CARRIAGE & WAGON COMPANY, LIMITED—The company is doubling its final dividend to 10 per cent. for the year to May 31, 1957, making a total of 15 (10) per cent. Group net profit rose by nearly £43,000 to £199,357.

WALLSEND SLIPWAY & ENGINEERING COMPANY, LIMITED—The conditions contained in the offer by Swan, Hunter, & Wigham Richardson, Limited, to the minority ordinary and preference holders of the company have now been fulfilled, and the offer has become unconditional.

INGALL, PARSONS, CLIVE & COMPANY, LIMITED, funeral furnishers, brassfounders, and diecasters, etc., of Birmingham—On its 10 per cent. non-cumulative participating preference shares the company pays 12½ (11½) per cent., and on its ordinary and deferred it pays 15 (12½) per cent. for the year to June 30, 1957. Group profit is £34,011 (£40,133) after tax of nil (same).

METAL BOX COMPANY, LIMITED—A spokesman for the company has denied a report that a rights offer is to be made. He said that the directors had no capital raising plans under consideration at the present time. The Malayan subsidiary, however, the Metal Box Company, of Malaya, was offering 1,500,000 $1 shares to existing shareholders at par on a one-for-three basis.

ACROW (ENGINEERS), LIMITED—According to the chairman, Mr. W. A. de Vigier, dividends in future will be paid quarterly instead of half-yearly. The first quarterly dividend for the current year will be declared in December. There was no doubt, he said, that the current year would be another record. They should be able to maintain the present dividend on the increased capital.

SANBRA, LIMITED, non-ferrous founders, of Birmingham—The company announces that negotiations initiated by another engineering concern have been terminated by that concern in view of recent financial and economic developments. However, discussions are now in progress with other companies who might make an offer for Sanbra shares, and the board is pursuing these possibilities.

E. CHALMERS & COMPANY, LIMITED, non-ferrous founders, of Edinburgh—The final ordinary dividend is 7½ (12½) per cent., making 12½ (17½) per cent. for the year to August 31, 1957. Consolidated profit is £33,568 (£94,137), subject to income tax of £13,300 (£39,000) and to profits tax of £8,750 (£12,700). Credit tax provision not required is £1,855 (£1,831), and net profit is £13,373 (£44,268).

WM. DOXFORD & SONS, LIMITED, engineers and shipbuilders, of Sunderland—The dividend on the £1,500,000 ordinary is being raised by 2½ per cent. for the third successive year. The final payment is 17½ (15) per cent., making 22½ (20) per cent. for the year to June 30, 1957. Group profits have advanced sharply from the adjusted figure of £935,883 to £1,109,233. The net profit is £533,233 (£467,883).

COCHRAN & COMPANY ANNAN, LIMITED, boilermakers and engineers, of Annan, Scotland—A proposed one-for-four free scrip issue subject to CIC consent is announced. Profits rose from £210,699 to £286,220 for the year to June 30, 1957, and after heavier tax of £144,895 (£111,594) the net balance is up from £99,075 to £141,325. The final dividend is 7 per cent., against 5½ per cent., making 10 (8½) per cent., tax free.

DELTA METAL COMPANY, LIMITED—An extra-ordinary meeting has been called for October 21 to approve the election to the board of Sir Horace Clarke, chairman and managing director of James Booth & Company, Limited, non-ferrous metal, etc., manufacturers, of Birmingham, for which the company recently made a successful offer. Mr. W. E. Ogden, chairman, says that this transaction, important though it is, does not mark the final stage in the company's development plans.

IMPERIAL CHEMICAL INDUSTRIES, LIMITED—A sharp rise in group sales and profits for the first half of 1957 is reported. Sales rose to £235,000,000 (£221,000,000) and the group income to £30,938,000 (£27,255,000). Employees' profit-sharing amounted to £1,740,000, compared with £1,580,000. After taxation and depreciation, net income was £2,300,000 up at £16,785,000. An unchanged interim of 4 per cent. on the £143,045,436 ordinary is announced. For 1956 a final of 6 per cent. made a total of 10 per cent.

JOHN DALE, LIMITED, founders, collapsible tube, etc., manufacturers, of London, N.11—The company's offer for the common shares of Modern Containers, Limited, Toronto, has been accepted in respect of over 99 per cent. of the shares and the take over arrangements have been completed. The board of Modern Containers has been reconstituted as follows:—Mr. W. E. H. Jones, president; Mr. J. W. Walker, vice-president; Mr. J. W. G. Collins, secretary-treasurer; Mr. A. T. Coote, Mr. F. Gerson, and Mr. F. W. Young.

KNITMASTER HOLDINGS, LIMITED (formerly Chinese Engineering & Mining, Limited)—The company has acquired the issued share capital of H. L. Reynolds, Limited, iron and steel stockholders and engineers, of Leeds. Consideration for the acquisition was £328,320, all of which has been provided from the group's liquid resources. Average profits of H. L. Reynolds, after all expenses and depreciation, but before directors' remuneration and tax for the five years ended September 30, 1956, amounted to £98,490 and the unaudited accounts for the 11 months to August 31, 1957, indicate maintenance of this figure. Surplus of assets over liabilities at August 31 was in excess of £500,000, no account being taken of goodwill.

CLIMAX ROCK DRILL & ENGINEERING WORKS, LIMITED—Morgan Grenfell & Company, Limited, announces that its offer to acquire on behalf of Holman Bros., Limited, mining, quarrying, public works, and pneumatic plant specialists, of Camborne (Cornwall), all the 357,030 issued ordinary shares of 5s. each of the company not already owned by Holmans, has been accepted by the holders of over 87 per cent. of such shares. Holmans has decided to take 87 per cent. acceptance in lieu of the 90 per cent. acceptance referred to in the offer. With the allotment of ordinary shares to be issued by Holmans, and subject to permission to deal in and quotation for such shares being granted by the Stock Exchange, London, the offer will become unconditional.

After 36 years with the Acme Engineering Company, Limited, sheet-metal workers and restaurant engineers, of Leeds, of which he was a director and general manager, Mr. CLARENCE COLLINGWOOD has retired.

Pig-iron and Steel Production

Statistical Summary of July Returns

The following particulars of pig-iron and steel produced in Great Britain are from statistics issued by the British Iron and Steel Federation. Table I summarizes activities during the past six months. Table II gives production of steel ingots and castings in July and Table III, weekly average production of finished steel. Table IV gives the production of pig-iron and ferro-alloys in July, and furnaces in blast. (All figures are weekly averages in thousands of tons.)

TABLE I.—*Iron and Steel Price Index and General Summary of Pig-iron and Steel Production.*

Period.	B.o.T. Price Index, 1938 = 100.			Iron-ore output.	Imptd. ore used.	Coke to blast-furnaces.	Pig-iron, ferro-alloys prod.	Scrap used in steel prod.	Steel (incl. alloy).			
	I. & S.	Coal.	Basic materials excl. fuel[1]						Imports.[2]	Prod. ingots, castings.	Delivrs. finished steel.	Stocks.[3]
1955	276	399	529	311	244	246	240	213	29	381	305	1,247
1956	295	454	542	312	272	264	253	216	27	397	318	1,444
1957—May[4] ..	318	465	554	341	310	272	284	234	13	443	340	1,438
June ..	317	466	540	322	302	274	275	222	14	419	317	1,483
July[4]	317	498	537	316	292	264	263	190	17	362	—	1,539

TABLE II.—*Weekly Average Production of Steel Ingots and Castings in* July, 1957

District.	Open-hearth.		Bessemer.	Electric.	All other.	Total.		Total ingots and castings.
	Acid.	Basic.				Ingots.	Castings.	
Derby, Leics., Notts., Northants and Essex ..	—	4.2	12.2 (basic)	2.4	0.1	17.7	1.2	18.9
Lancs. (excl. N.W. Coast), Denbigh, Flints. and Cheshire	1.8	31.7	—	2.2	0.3	34.8	1.2	36.0
Yorkshire (excl. N.E. Coast and Sheffield) ..								
Lincolnshire	—	31.9	—	—	0.1	31.9	0.1	32.0
North-East Coast	0.8	74.0	—	1.3	0.3	74.6	1.8	76.4
Scotland	1.2	26.1	—	1.4	0.3	27.7	1.3	29.0
Staffs., Shrops., Worcs. and Warwick	—	17.2	—	1.2	0.6	17.3	1.7	19.0
S. Wales and Monmouthshire	3.8	82.0	7.5 (basic)	1.0	0.2	93.9	0.6	94.5
Sheffield (incl. small quantity in Manchester) ..	7.8	32.0	—	10.0	0.4	48.4	1.8	50.2
North-West Coast	—	1.4	4.6 (acid)	0.5	—	6.4	0.1	6.5
Total	15.4	300.5	24.3	20.0	2.3	352.7	9.8	362.5

TABLE III.—*Production of New Non-alloy and Alloy Finished Steel.*

Product.	1955.	1956.	1956.	1957.	
			June.	June.	First six months.
Non-alloy steel:					
Ingots, blooms, billets and slabs[5]	4.9	4.7	4.7	4.7	5.1
Heavy rails ..	9.4	9.7	9.1	11.4	11.7
Sleepers etc. ..	2.0	1.8	1.9	1.6	2.4
Plates, 3mm. and over	46.1	50.2	55.3	47.4	52.4
Other heavy prod.	47.8	50.3	52.1	54.4	55.2
Ferro-concrete bars and rods ..	7.0	7.8	8.1	9.4	8.7
Wire rods	22.2	22.9	23.1	23.2	23.2
Arches, etc. ..	9.6	10.1	10.0	11.7	11.6
Other light sections	36.8	41.4	44.2	37.0	41.6
Bright steel bars ..	7.8	8.0	8.5	7.0	7.3
Hot-rolled strip ..	24.1	24.5	25.9	21.4	23.6
Cold-rolled strip ..	8.1	7.5	8.3	6.6	6.9
Sheets, incl. coated					
(i) Hot rolled ..	16.6	15.0	14.8	11.9	13.1
(ii) Cold reduced	26.1	24.8	22.9	29.1	28.9
Tin and terneplate	15.6	15.9	15.3	18.8	20.3
Blackplate ..	1.4	1.3	1.3	0.8	0.9
Steel tubes, pipes ..	22.9	26.2	28.1	25.5	26.3
Tube, pipe fit'gs. ..	0.4	0.5	0.5	0.5	0.5
Tyres, wheels, axles	4.8	4.6	5.1	5.1	5.0
Forgings (excl. drop forgings) ..	2.5	3.0	3.3	3.4	3.2
Steel castings ..	4.2	4.5	5.0	5.1	4.7
Tool and magnet steel	0.3	0.3	0.3	0.4	0.4
Total	320.6	335.0	339.9	341.4	355.9
Alloy steel	15.8	17.3	18.3	17.4	17.6
Total deliveries from U.K. prod.[6] ..	336.4	352.3	358.2	358.8	373.5
Add : Imported finished steel ..	18.9	19.5	23.9	7.5	8.2
	355.3	371.8	382.1	366.3	381.7
Deduct: Intra-industry conversion[7] ..	50.9	55.2	58.2	50.2	53.9
Total new material ..	304.4	316.6	323.9	316.1	327.8

TABLE IV.—*Production of Pig-iron and Ferro-alloys during* July, 1957*

District.	Furnaces in blast.	Hematite.	Basic.	Foundry.	Forge.	Ferro-alloys.	Total.
Derby, Leics., Notts., Northants and Essex	25	0.6	28.5	19.6	0.4	—	49.1
Lancs. (excl. N.W. Coast), Denbigh, Flints. and Cheshire ..	6	—	21.7	—	—	0.7	22.4
Yorkshire (excl. N.E. Coast and Sheffield) ..	—	—	—	—	—	—	—
Lincolnshire ..	9	—	35.0	—	—	—	35.0
North-East Coast	20	4.9	51.6	—	—	0.9	57.4
Scotland	10	0.9	13.2	1.5	—	—	15.6
Staffs., Shrops., Worcs., and Warwick ..	7	—	10.3	1.6	—	—	11.9
S. Wales and Monmouthshire	11	4.6	46.4	—	—	—	51.0
Sheffield	1	—	1.8	—	—	—	1.8
North-West Coast	9	17.4	—	0.2	—	1.6	19.2
Total ..	98	28.4	208.5	22.9	0.4	3.2	263.4
June, 1957 ..	99	32.9	216.1	21.8	0.6	3.2	274.6
July, 1956 ..	98	25.2	182.8	27.7	0.8	3.8	240.3

[1] Used in non-food-manufacturing industry.
[2] Weekly average of calendar month.
[3] Stocks, mainly ingots and semi-finished, at the end of the years and months shown.
[4] Five weeks, all tables.
[5] Other than for conversion into any other form of finished steel listed.
[6] Includes finished steel produced in the U.K. from imported ingots and semi-finished steel.
[7] Material for conversion into other products also listed in this table.

News in Brief

LEC REFRIGERATION, LIMITED, Bognor Regis, have recently received from Canada an order for compressors to the value of $650,000—the largest single order from that country.

A BRIDGE, carrying a railway and connecting its existing works at West Hartlepool with a large new steelworks to be constructed on the site of Greatham Airport, is to be constructed by the South Durham Steel & Iron Company, Limited.

THE name of Costain-John Brown, Limited, constructional and mechanical engineers, of Grangemouth, Scotland, which is a wholly-owned subsidiary of John Brown & Company, Limited, Clydebank, is now Constructors John Brown, Limited.

ASTRAL EQUIPMENT LIMITED, Dundee, a subsidiary of Morphy-Richards, Limited, has been awarded a national contract, placed by the Gas Council, for refrigerators. The contract, said to be the largest ever placed in Britain, will mean full employment for Astral workers until December, 1958.

THE BRITISH STANDARDS INSTITUTION *Information Sheet* for September announces the publication of a revised standard No. 470:1957 for "Manhole and Inspection Openings for Chemical Plant." It costs 3s. and is obtainable from the British Standards Institution, 2, Park Lane, London, W.1.

SIXTEEN 88-h.p. 0-6-0 type diesel-mechanical locomotives have been ordered from the Hunslet Engine Company, Limited, Leeds, by the Sudan Gezira Board. Each unit weighs 12¼ tons. This is the fifth order by the board for Hunslet locomotives specially designed for its cotton plantation railway system.

ORDERS WORTH NEARLY £1,500,000 for 200 bogie covered goods wagons and 500 bogie high-sided wagons have been awarded to the Metropolitan-Cammell Carriage & Wagon Company, Limited, Birmingham, by Rhodesia Railways. Orders for more than 4,000 bogie high-sided wagons have now been placed with the company in the past 10 years.

THE LAST STEAM LOCOMOTIVE to be built at the Doncaster works of British Railways will be completed on October 16 and the works, which have been in existence for 104 years, will in future deal mainly with repair and maintenance. The steam era at Doncaster will be followed by a diesel locomotive building programme of 350-h.p. shunting engines.

IN ASSOCIATION with the American Brake Shoe Company, Lloyds (Burton), Limited, Burton-on-Trent, is to undertake production, with new processes, of alloys and castings for the aircraft tyre-making and general engineering industry. The new work will double the size of the Wellington Street foundry, and the company is to increase its works staff by 300.

RAISING TO OVER 2,300 its total orders from Canada since February, the International Harvester Company of Great Britain, Limited, London, E.C.1, has received an order for 900 B-250 tractors for shipment to Canada in the early part of 1958. Total shipments to Canada have mounted to $2,250,000 for the past six months. The new order raises the total to $3,500,000.

PROMPT ACTION BY EMPLOYEES undoubtedly prevented a serious fire spreading at the iron and brass foundry of A. Brown & Sons, Foyle Street, Londonderry, when sparks from an electric welder ignited loose oil and sawdust near drums of oil stored on a wooden gantry. Employees shovelled earth on to the flames and the fire was extinguished shortly before the arrival of the City Fire Brigade.

INDUSTRIAL PRODUCTION has been steady for the past three months. After rising sharply in May and June the official index has remained roughly the same for June, July, and August, running about 4 per cent. above the rate for the same period of 1956. The index number of industrial production, prepared by the Central Statistical Office, for all industries for August, is expected to be 120-121 (1948=100). The index for August, 1956, was 113.

THE BRUNEL COLLEGE OF TECHNOLOGY, Acton (Middx), opened by the Minister of Education last week, is the first major new technical college building to be completed since the publication of the White Paper on technical education. It will be capable of housing 1,200 students and teaching staff and will cost about £2,000,000. Over half its 30 laboratories will be allocated to advanced work, post-graduate research, and specialized technological studies.

THE OLD LMS RAILWAY STATION at Bothwell, Lanarkshire, left a roofless skeleton when British Railways closed it in 1950, has been converted into a modern factory by the Belmos Company, Limited, of Bellshill and High Blantyre, for the manufacture of precision electrical equipment. Some plant has already been installed and production has begun of synchronous motors. This particular kind of equipment has never before been made in Scotland.

A NEW MAJOR OPERATING DIVISION of the Allis-Chalmers Manufacturing Company, of Milwaukee, United States, has been formed with the name Allis-Chalmers International. It will be responsible for all manufacturing, engineering, and sales operations and activities outside of the US and Canada. Manufacturing operations include plants at Essendine (Rutland), which produces wheel tractors, harvesters and vibrating screens, and at New Castle, Australia, where motor graders are now manufactured.

AN ORDER for 1,000 Ferguson tractors with accessories and 6,500 implements, worth £1,100,000, has been secured by Massey-Harris-Ferguson (Export), Limited, Coventry, from Yugoslavia. Delivery will start immediately and is required to be completed by the end of this year. The diesel engines for the tractors will be supplied by F. Perkins, Limited, Peterborough. A separate order for 600 Perkins four-cylinder diesel engines for the Yugoslav Zadrugar tractor has also been received by the Peterborough company.

THE BOARD OF TRADE give notice that they are considering an application for an increased protective duty on lighter flints, defined as follows:— Ferro-cerium and other pyrophoric alloys, in any form, whether or not coated with other materials, in pieces weighing not more than one ounce. Any representations which interested parties may wish to make in regard to this application should be addressed in writing to the Board of Trade, Tariff Division, Horse Guards Avenue, Whitehall, London, S.W.1, not later than October 24, 1957.

IN FACE of intense international competition, A.C.V. Sales, Limited, a subsidiary of Associated Commercial Vehicles, Limited, London, W.1, has received an order for 250 complete double-deck omnibuses with maintenance spares from the Teheran Omnibus Board. The chassis will be A.E.C. "Regent" Mark V with Monocontrol transmission and the bodies will be constructed by Park Royal Vehicles, Limited, London, N.W.10. This order, the largest ever received from oversea by any British commercial vehicle manufacturer for com-

News in Brief

plete double-deck buses, represents a total value of approximately £2,500,000.

MANAGEMENT in a time of full employment is difficult because no one really knew "what makes people tick," said Mr. J. A. Hunt, general manager of the Hymatic Engineering Company, Limited, Redditch, in Birmingham on September 28, when he addressed the closing session of the national conference of the Institutional Management Association. Rights were being demanded first, he said, but he thought it unreasonable to believe that responsibility was very far behind. Most people were responsible individuals at bottom—but there was a lack of knowledge as to what it was that made them feel more responsible.

RECENTLY FOUNDRY STUDENTS from Scunthorpe North Lindsey Technical College saw apprentices learning the moulding trade when they visited Newton Chambers & Company, Limited, Thorncliffe, Sheffield. At the company's apprentice training centre, the students had the opportunity of examining a wide range of equipment used by the firm's apprentices. A particular point of interest was the cupola made for the training foundry by boys in the constructional engineering department of the training centre. A five-hour tour of Thorncliffe included a visit to the works cinema to see the "Thorncliffe Film."

AN EXHIBITION to bring industry the latest information about the uses and developments of nickel, nickel alloys, and related materials, is to be held by the Mond Nickel Company, Limited, at the Royal Station Hotel, Newcastle-upon-Tyne, from November 5 to 8. Displays and working demonstrations are planned to show corrosion resistance, surface protection, high magnetic permeability, weldability, controlled expansion, and mechanical properties at temperatures between 900 deg. C. and sub-zero. Part of the exhibition will be devoted to spheroidal graphite cast-iron, and will feature specimens and mechanical strength tests.

THE INDUSTRIAL WELFARE SOCIETY, is organizing an introductory course for managers, training and personnel officers, and those concerned with running meetings and discussion groups, to be held at Robert Hyde House, 48, Bryanston Square, London, W.1, November 19 to 20. The aim of the course is to provide some insight into how groups function, and to give opportunities to practise group leadership skills. The number of delegates will be limited so that full benefit can be obtained from practical demonstrations and discussions. Details of the course are available from the secretary of the Society at the address quoted.

THE MANUFACTURE of over 2,200 nautical miles of the total submarine telephone cable required for the second trans-Atlantic project, for laying between America and France by the American Telephone and Telegraph Company, has been entrusted to the British firm, Submarine Cables, Limited, owned jointly by Siemens Edison Swan, Limited, and the Telegraph Construction and Maintenance Company, Limited. The British share of the cable, costing more than £3,000,000, will be made at Ocean Works, Erith, where Submarine Cables, Limited, produced over 92 per cent. of the submarine cable required for the first trans-Atlantic telephone system which was opened for service last September.

CATERPILLAR TRACTOR COMPANY, LIMITED, Leicester, is carrying through an expansion programme which will almost double its floor space. The location of the Leicester plant was formerly on an airfield; these works replaced their first British plant at Coalville, Leicester, about 18 months ago, and the plant has been in full operation since March, 1956. During the last few months an additional 100,000 sq. ft. of floor space has been adapted to the company's use and the number of employees has risen by 25 per cent. in 12 months to a total of 430. The company at Leicester is engaged in the procuring of replacement parts to specifications of Caterpillar Tractor Company, Peoria, USA, and distributing the parts to all non-dollar areas all over the world.

GIVING THE SWINBANK LECTURE, Mr. Arthur Elliott (Precision Rubbers, Limited), speaking of the commodity markets, said that "we must, as buyers, be frank enough to admit that after the war we were sheltered by governmental supply departments and we liked the idea of fixed prices. . . . However, terminal and future markets, when efficiently used, essentially function to benefit producers and consumers. The proper function of terminal markets is to enable buyers to reduce their risks by transferring them to those people who are organized to take such risks." He continued: "Purchasing officers whose duty it is to evaluate the prices they have to pay for goods and services, know full well the reasons underlying price advances in recent years. There must be concerted resistance against paying higher prices which arise from unjustified wage awards."

A REPORT has been received of the Metalock "cold-stitching" process being applied to the repair of two antique iron castings—a 15th-century fireback and a 50-year-old Royal locomotive crest. Briefly, this process entails drilling a number of lines of "blind" holes across a fracture, joining the holes together by cutting a narrow channel between them, and then driving into the cavities a number of specially shaped pieces of metal or "keys." Each key is pneumatically hammered into its housing. The Royal locomotive crest was from the British Transport Commission's collection of historical relics which has been used on Royal trains, probably as far back as the Victorian era. The fireback was from an Adam fireplace at The Hall, Bradford-on-Avon. This casting has been in use for over 500 years, and is now expected to live through another long period similarly employed.

DESPITE STRONG INTERNATIONAL COMPETITION, the Glasgow foundry and engineering firm of G. & J. Weir, Limited, has secured a £500,000 order for seawater evaporating and distilling plant for the Bahamas. The plant will provide one million gallons of fresh water daily for the Bahamas Electricity Corporation. It follows closely on recent export orders for large seawater distillation plants at Kuwait (Persian Gulf), Curaçao and Aruba (Netherlands Antibes). The total value of these orders runs into several millions of pounds. A feature of the equipment for the Bahamas order is that it will be made largely of stainless steel in an entirely new design and fabricated at the site. Each plant will have a main structure 32-ft. high, containing compartments which form an evaporating plant of the submerged-tube type, which has been found to be the most economical and efficient in operation. The Weir group will supply the necessary distillers, condensers, pre-heaters, and pumps for each unit. The plant is due for completion in August, 1959.

TURNER & NEWALL, LIMITED—Mr. R. M. Bateman, Mr. N. A. Morling, Mr. G. S. Sutcliffe, and Mr. J. A. E. Clogg have been appointed to the board as from November 1. The new directors, who have all been with the Turner & Newall organization for some years, will continue as chairmen of the group's subsidiary companies in the UK.

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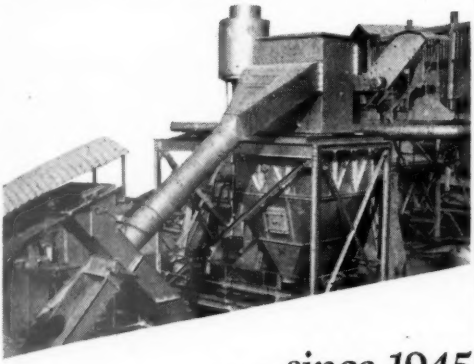

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Personal

Mr. W. MOELLER has been elected to the board of Cochran and Company (Annan), Limited.

Mr. R. W. GOURDIE and Mr. T. A. NANSON have been appointed directors of Acrow (Engineers), Limited, of Leeds.

Mr. H. G. SHOWELL has been appointed registrar of Metal Industries, Limited, in succession to the late Mr. J. LAW.

Sir LEWIS JONES, LL.D., recently completed 40 years' service as secretary of the South Wales Siemens Steel Association, Swansea.

Mr. A. B. S. YOUNG, Mr. L. J. FOWLER and Mr. N. E. W. BAKER have been elected directors of Horseley Bridge and Thomas Piggott, Limited.

Dr. C. M. KRUGER, general manager of Iscor, has been appointed chairman of the Iron and Steel Producers' Association of South Africa.

Alldays & Onions, Limited, announce that Mr. J. S. ERSKINE has been appointed sales manager. His appointment commenced as from October 1.

Mr. R. G. GILLESPIE and Mr. JAMES MITCHELL have retired from the board of Mitchell, Russell & Company, Limited, ironfounders, Bonnybridge, Scotland.

Mr. ROBERT J. B. WILLIAMS has been appointed office manager of the head office of the United Steel Companies, Limited, at Broomhill, Sheffield. He will take up his new post at Christmas.

Mr. F. BATES, who retired on September 27, after 50 years' service in the Grice Street foundry of Geo. Salter & Company, Limited, West Bromwich, received gifts from the directors and fellow workers.

Mr. J. C. DORSIE, director and chief draughtsman, of Cameron & Roberton, Limited, Southbank Ironworks, Kirkintilloch, has been presented with gifts on his retirement after 60 years' service with the firm.

Mr. E. G. BERGIOUS has been appointed sales and service manager of Matthew Wylie & Company, Limited, woodworking machinery manufacturers, Glasgow. Mr. D. BELL has been appointed export manager.

Mr. WHEATON T. FREESTONE, works director of Peter Brotherhood, Limited, engineers and ironfounders, etc., of Peterborough, is to retire. Mr. Freestone, who has been with the company for 50 years has been a director since 1934.

Mr. E. L. BURTON, B.A., A.C.A., has been appointed secretary of Tube Investments, Limited, in succession to Mr. I. N. TURNER, who has taken up other duties in the group. Mr. Burton retains his responsibilities as chief accountant.

Mr. J. L. YOUNGER, who for a number of years has been foundry manager, Blackstone & Company, Limited, Stamford, has been appointed manager of the foundry division National Gas & Oil Engine Company, Limited, Ashton-under-Lyne, Lancs.

Mr. H. T. CADBURY-BROWN has been appointed consulting engineer to the Turners Asbestos Cement Company, Limited, Manchester, a member of the Turner & Newall, Limited, organization. He will assist in future designing of asbestos cement products.

Guy Motors, Limited, announce that following the retirement of Mr. SYDNEY S. GUY, Mr. ARTHUR L. BLOWER takes over the office of chairman, Colonel ARTHUR JERRETT becomes managing director, and Mr. TREVOR GUY joins his brother, Robin, on the board of directors.

Mr. ARTHUR WHITELEY, who has retired from the staff of General Refractories, Limited, Sheffield, was the recipient of gifts from both directors and colleagues. He was an original member of the staff when the company was formed by the late Mr. Frank Russell taking over an earlier concern called Kelham Island Firebrick Company, Limited. Mr. Whiteley has been connected with the Refractories Association of Great Britain since its inception and served it in the capacities of honorary secretary and treasurer. He is now an honorary life member and vice-president.

Sir GEORGE BEHARRELL has resigned from the presidency of the Dunlop Rubber Company, Limited, and therefore from the board, but has consented to act as an honorary consultant. Lord BAILLIEU has resigned from the chairmanship of the company but remains on the board and succeeds Sir George Beharrell as president. Mr. G. E. BEHARRELL becomes chairman of the board in succession to Lord Baillieu and will continue to act as chief executive of the company. Mr. JOHN H. LORD and Mr. R. M. GEDDES both have been appointed managing directors, and Mr. T. E. PEPPERCORN has been made an executive member of the board.

Obituary

The death has taken place at Winchester, at the age of 90, of Mr. CHRISTOPHER WAGHORN, retired brass founder, formerly of Garfield Works, Halifax.

Mr. H. D. MCLEAN, a director of Roberts & Company (Wednesbury), Limited, and Atlas Brassfoundry (Birmingham), Limited, died on September 27 at the age of 57.

Mr. T. H. BELL, who has died at the age of 73, was a maintenance engineer at Bryan Donkin & Company, Limited, of Chesterfield, for more than 50 years until his retirement.

Mr. W. H. BULPITT, managing director of Bulpitt & Sons, Limited, manufacturers of the Swan brand of aluminium, died on October 4 at the age of 79. Mr. Bulpitt joined the company in 1893 and became chairman in 1910 on the death of his father.

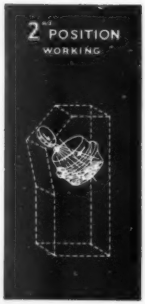
The death is announced from Paris of Mr. J. W. PENICUD, furnace designer and builder. He went to Paris originally as a representative of the Morgan Crucible Company, Limited, and settled there. During the war he was interned at the British Civilian Prisoners Camp at St. Denis. He was 73 years old.

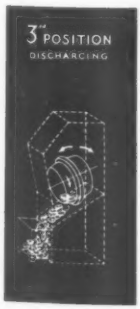
Hadfields' Staff Changes

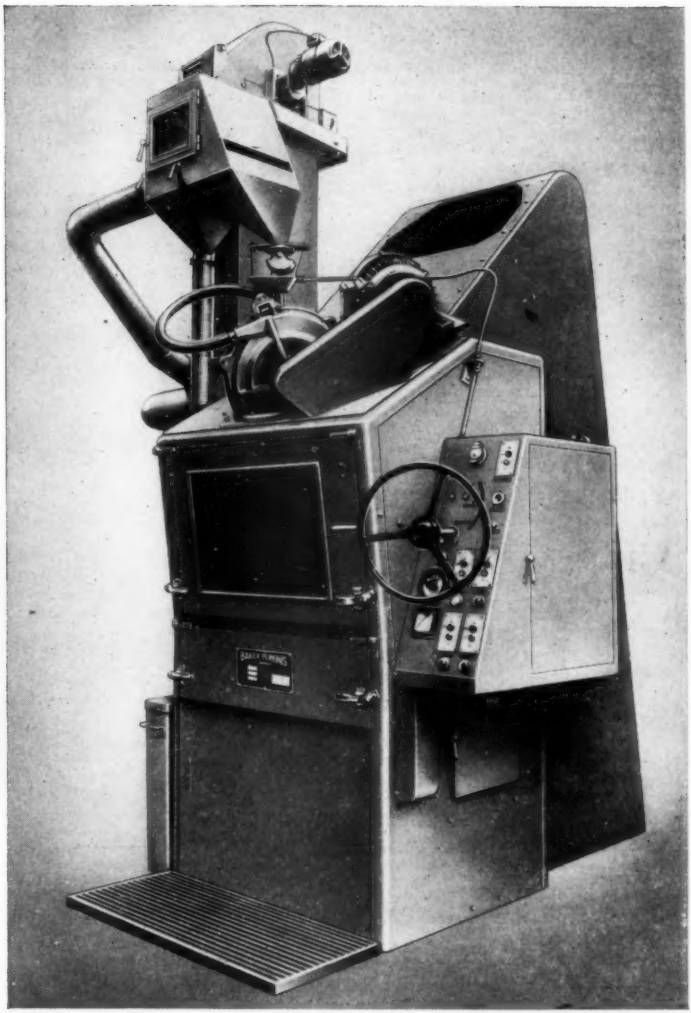
The paragraph in the September 26 issue of the JOURNAL referring to staff changes at Hadfields, Limited, was incorrect in several respects. Owing to a transposition of a line, it was not made clear that it is Mr. S. Leetch, M.C., works controller, whose retirement on September 30 was announced. He joined the company in 1946 as steel foundry controller and was later appointed local director and works controller. In the same paragraph, it is of course, *Dr.* J. R. Rait and *Dr.* L. G. Finch, B.MET., who were referred to; the former has left Hadfields to become joint managing director of Briton Ferry Steel Company (a subsidiary of Duport, Limited), and Dr. Finch has been made deputy research controller of Hadfields, Limited. The transposition of the line also made it appear that Hadfields Foundry & Engineering Company, Limited, is a subsidiary of Duport, Limited, which it is not.

BAKER PERKINS Shot Blast Equipment

Rotating Barrel Shot-Blast Machine







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Raw Material Markets

Iron and Steel

Producers are able to satisfy most requirements without difficulty from the increasing outputs of pig-iron which are now being obtained. Only in the low-phosphorus foundry pig-iron is demand approaching output. The additional blast-furnace capacity, recently brought into operation, together with the changeover of furnaces from foundry irons to basic pig-iron, now provides the steelworks with adequate quantities for consumption requirements. It is also enabling them to build up reserves, augmented by the consignments from abroad. Although a larger percentage of pig-iron is now being used by the steelworks, current deliveries appear to be sufficient to meet the rising ingot-steel production. This will continue to depend mainly on the usage of pig-iron rather than scrap, supplies of which are of a variable nature, particularly in the higher grade material. It is understood that for the future imported supplies of basic pig-iron and scrap will be curtailed.

In the foundry grades of pig-iron, brisk demands continue to come for hematite and low-phosphorus irons from the engineering and speciality foundries making high-duty castings and the furnaces have so far been able to keep the foundries supplied with adequate tonnages. Hematite pig-iron is fairly plentiful, but the low-phosphorus pig-irons, production of which is on a lower scale than hematite, are practically fully absorbed by present demands. A fair tonnage of refined iron is also being used, but makers can accept more business.

There is little difficulty in obtaining high-phosphorus pig-iron in the normal analyses, and only for the higher silicon ranges is there any delay in despatch against current orders. Makers would welcome more business, but there is little sign of improvement as most of the foundries using this grade are short of work; in fact, some of the light, jobbing, and textile foundries are on short time, and capacity, particularly in the mechanized sections, is not fully employed. Producers of the high-phosphorus pig-iron continue to add to stocks, of which they are being relieved to some extent by export orders, and fairly good tonnages are being sent overseas. All other grades of foundry and refined irons are available for the export market when licences can be obtained.

Recently there has been an increase in the supply of steel semis from home steelworks, and most producers could accept more business. Many of the re-rollers, however, are well stocked, and until these stocks are reduced they are unable to accept additional supplies, particularly in the smaller-sized billets, the demand for which has declined appreciably owing to the scarcity of orders for small bars and light sections. Specifications from both stockists and consumers have declined in tonnage, and while some export business is on hand competition is very keen from overseas makers for any business which arises. Re-rollers of reinforcing rods are very busy and there is continued improvement in the demand for sheets and strip.

Non-ferrous Metals

The prices of the base metals are still depressed and there have been no new developments during the past week calculated to send them to higher levels.

The tone of the copper market generally remains weak and there has been no great reaction to the news that the Rhodesian Selection Trust group of companies is to resume selling its copper on the basis of the London Metal Exchange price. The RST decision was taken in response to a request from the British Non-ferrous Metals Federation, as representing United Kingdom copper fabricators. The federation asked that the trust should drop the fixed price policy which it introduced in May, 1955, with the primary object of overcoming the disadvantages of fluctuating Metal Exchange prices. It was felt that these fluctuations, allied to the high price, were driving consumers to find substitutes for copper. RST therefore decided to sell at a fixed price related to a world average. This policy is now apparently an embarrassment both to the Rhodesian Selection Trust and the fabricators in this country.

When the fixed price decision was made in May, 1955, copper was quoted on the London Metal Exchange at around £320 per ton. The current quotation is almost down to £190.

Consumers are still not interested buyers of copper and the news that world stocks of blister and refined copper are probably around 1,000,000 tons is not calculated to create a change of mind.

Official warehouse stocks of tin rose last week and this fact, coupled with the knowledge that things are not going too well in the Welsh tinplate trade, led to further weakness in price.

Lead and zinc have eased with the general trend and in these metals, too, buying interest is small.

Forthcoming Events

OCTOBER 11

Institute of British Foundrymen

Bristol & West of England branch:—"Use of Epoxide Resins for Patternmaking," by J. F. Bowers, 7.30 p.m., at the Grand Hotel, Bristol.

OCTOBER 14

Institution of Works Managers

Manchester branch:—"Problems of Restriction of Output," by T. Lupton, 6.45 p.m., at the Grand Hotel.

OCTOBER 15

Institute of British Foundrymen

Coventry and district section:—Presidential address followed by "Personnel Relationship in the Foundry," by H. E. Robinson, 7.30 p.m., at the Coventry Technical College, Room A.5.

East Anglian section:—Presidential address and paper, by R. E. Berry, 7.30 p.m., at the Lecture Hall, Public Library, Ipswich.

National Society of Master Patternmakers

Visit to the naval shipyard of Vickers-Armstrongs, Limited, Newcastle-upon-Tyne, 2 p.m., followed by dinner and social evening at the Douglas Hotel, commencing 7.15 p.m.

OCTOBER 15 to 17

Corrosion Exhibition

Royal Horticultural Society's Old Hall, Westminster, London, S.W.1. Open on October 15 from 10.30 a.m. to 8 p.m., October 16, 10 a.m. to 8 p.m., and October 17, 10 a.m. to 5 p.m. A corrosion convention will be held at the Central Hall, Westminster, from October 15 to 16.

OCTOBER 16

Institution of Production Engineers

Western section:—"Engineering in the Field of Atomic Energy," by J. R. V. Dolphin, C.B.E., at the Small Lecture Theatre, Engineering Faculty, University of Bristol.

Wolverhampton section:—"Practical Research into Machining Problems," by J. Cherry, 7.15 p.m., at the Wolverhampton College of Technology, Wulfruna Street.

OCTOBER 17

Institution of Production Engineers

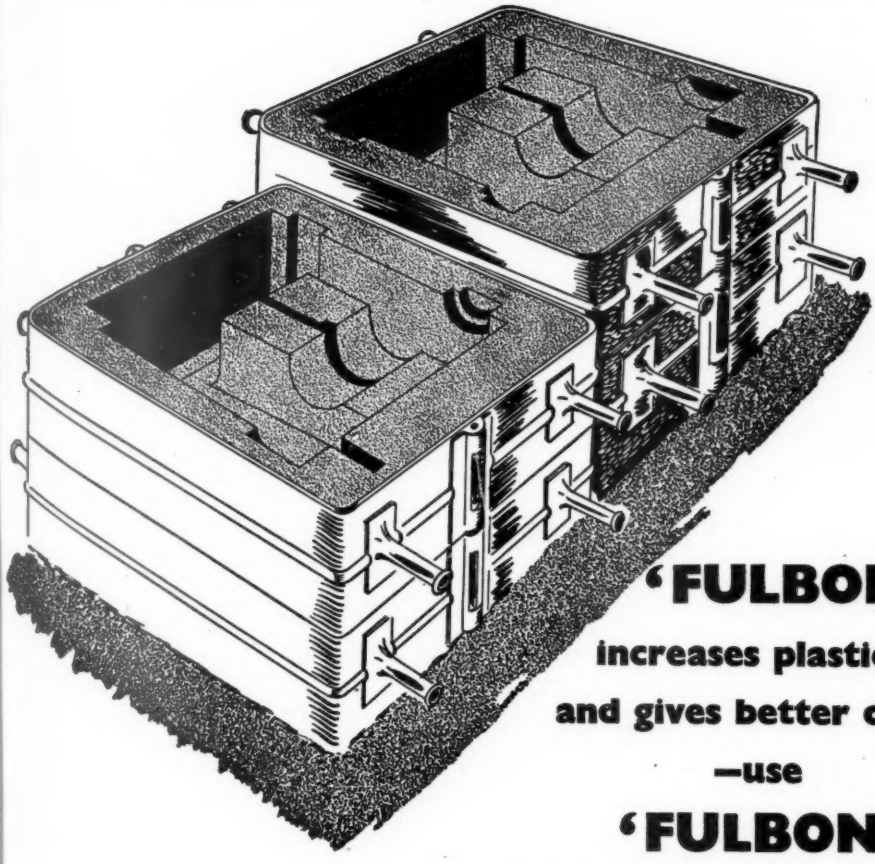
London section:—"Electronics as an Aid to Production," by T. A. Waite, B.SC., 7.15 p.m., at the Royal Empire Society, Northumberland Avenue, London, W.C.2.

Luton section:—"New Approach to Production Control," by J. L. Burbidge, 7.30 p.m., in the staff canteen, S.K.F., Limited.

Institute of British Foundrymen

Northampton and district section:—"Dimensionally Accurate Castings," by J. Hill, 7.30 p.m., at the Georgian Room, Hind Hotel, Wellingborough.

DEEP DRAWS...



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Current Prices of Iron, Steel, and Non-ferrous Metals

(Delivered unless otherwise stated)

October 9, 1957

PIG-IRON

Foundry Iron.—No. 3 IRON, CLASS 2:—Middlesbrough, £21 6s. 0d.; Birmingham, £20 18s. 3d.

Low-phosphorus Iron.—Over 0.10 to 0.75 per cent. P, £23 17s. 0d., delivered Birmingham. Staffordshire blast-furnace low-phosphorus foundry iron (0.10 to 0.50 per cent. P, up to 3 per cent. Si), d/d within 60 miles of Stafford, £24 1s. 3d.

Scotch Iron.—No. 3 foundry, £25 3s. 6d., d/d Grangemouth.

Cylinder and Refined Irons.—North Zone, £25 19s. 0d.; South Zone, £26 1s. 6d.

Refined Malleable.—P, 0.10 per cent. max.—North Zone, £27 6s. 6d.; South Zone, £27 9s. 0d.

Hematite.—Si up to 2 per cent., S. & P. over 0.03 to 0.05 per cent.:—N.-E. of England (local iron), £25 6s. 6d.; Scotland (Scotch iron), Zone S. 1, £25 13s. 0d.; Sheffield, £26 15s. 0d.; Birmingham, £27 4s. 0d.; Wales (Welsh iron), £25 6s. 6d.

Basic Pig-iron.—£20 3s. 0d., delivered Staffs, Derbyshire, Notts, Lincs, Rutland, Northants, and Leics.

FERRO-ALLOYS

(Per ton unless otherwise stated, delivered)

Ferro-silicon (6-ton lots and over).—45 per cent. Si, £50 0s. 0d. to £52 15s. 0d., scale 17s. 0d. to 17s. 6d. per unit; 75 per cent. Si, £70 0s. 0d. to £76 7s. 6d., scale 17s. 0d. to 17s. 6d. per unit.

Ferro-vanadium.—50/60 per cent., 28s. 6d. per lb. of V.

Ferro-molybdenum.—65/70 per cent., carbon-free, 12s. 6d. per lb. of Mo.

Ferro-titanium.—20/25 per cent., 2-3 per cent. Cu, £250 0s. 0d.; 38/40 per cent., commercially carbon-free, £299 0s. 0d.

Ferro-tungsten.—80/85 per cent., 9s. 7d. per lb. of W.

Tungsten Metal Powder.—98/99 per cent., 12s. 7d. per lb. of W.

Ferro-chrome (6-ton lots and over).—4/6 per cent. C, £96 0s. 0d. to £99 10s. 0d., basis 60 per cent. Cr, scale 33s. 0d. per unit; over 6 per cent. C, £94 0s. 0d., basis 60 per cent. Cr, scale 31s. 0d. to 33s. 0d. per unit; 2 per cent. C,* 2s. 2d. per lb. Cr.; 1 per cent. C,* 2s. 2½d. per lb. Cr; 0.15 per cent. C,* 2s. 3d. to 2s. 3½d. per lb. Cr; 0.10 per cent. C,* 2s. 3½d. to 2s. 3⅝d. per lb. Cr; 0.06 per cent. C,* 2s. 3½d. to 2s. 4d. per lb. Cr.

Metallic Chromium.—98/99 per cent., 7s. 3d. to 7s. 10½d. per lb.

Metallic Manganese.—90/92 per cent., carbon-free, £290 0s. 0d.; 96/98 per cent., £310 0s. 0d.

Ferro-columbium.—65/75 per cent., Nb + Ta, 22s. 0d. to 23s. 0d. per lb., Nb + Ta.

Ferro-manganese (home).—78 per cent., £87 19s. 3d.

SEMI-FINISHED STEEL

Re-rolling Billets, Blooms, and Slabs.—BASIC: Soft, u.t., £33 1s. 6d.; tested, 0.08 to 0.33 per cent. C, £34 1s. 6d.; hard (0.41 to 0.60 per cent. C), £35 3s. 0d.; silico-manganese, £44 2s. 6d.; free-cutting, £37 5s. 6d. SIEMENS MARTIN ACID: Up to 0.25 per cent. C, £41 7s. 0d.; silico-manganese. £44 10s. 0d.

Billets, Blooms, and Slabs for Forging and Stamping.—Basic, soft, up to 0.33 per cent. C, £38 16s. 0d.; basic, hard, over 0.41 up to 0.60 per cent. C, £39 18s. 6d.; acid, up to 0.25 per cent. C, £43 10s. 0d.

FINISHED STEEL

Heavy Plates and Sections.—Ship plates (N.-E. Coast), £42 12s. 0d.; boiler plates (N.-E. Coast), £45 2s. 0d.; floor plates (N.-E. Coast), £44 1s. 0d.; angles, N.-E. Coast, £40 6s. 6d.; joists, N.-E. Coast, £40 2s. 6d.

Small Bars, Sheets, etc.—Rounds and squares, under 3 in., and flats, 5 in. wide and under, untested soft basic, 50 tons and over, £40 8s. 0d. (under 10 tons to 4 tons, £41 5s. 6d.; under 4 tons to 2 tons, £41 10s. 6d.); hoop and strip, coils, £40 10s. 0d.; uncoated strip mill coils, hot rolled, under 3mm. to 12g., £45 16s. 0d.; black sheets (hand mill), 24 g., 59 4s. 6d.; galvanized corrugated sheets, 24 g., £68 17s. 0d.

Alloy Steel Bars.—1 in. dia. and up: Nickel, £69 9s. 6d., nickel-chrome, £100 12s. 6d.; nickel-chrome-molybdenum, £112 16s. 6d.

NON-FERROUS METALS

Copper.—Cash, £189 5s. 0d. to £189 15s. 0d.; three months, £192 10s. 0d. to £193 0s. 0d.; settlement, £189 15s. 0d.

Copper Tubes, etc.—Solid-drawn tubes, 1s. 10⅜d. per lb.; rods, 217s. 6d. per cwt. basis; 20 s.w.g., 284s. 6d. per cwt.

Tin.—Cash, £730 0s. 0d. to £730 10s. 0d.; three months, £733 0s. 0d. to £733 10s. 0d.; settlement, £730 10s. 0d.

Lead (Refined Pig).—First half October, £87 10s. 0d. to £87 15s. 0d.; first half January, £88 0s. 0d. to £88 5s. 0d.

Zinc.—First half October, £70 0s. 0d. to £70 5s. 0d.; first half January, £70 0s. 0d. to £70 5s. 0d.

Zinc Sheets, etc.—Sheets, 15g. and thicker, all English destinations, £103 15s. 0d.; rolled zinc (boiler plates), all English destinations, £101 10s. 0d.; zinc oxide (Red Seal), d/d buyers' premises, £85.

Brass Tubes, etc.—Solid-drawn tubes, 1s. 6⅝d. per lb.; sheets to 10 w.g., 165s. 0d. per cwt.; wire, 2s. 4¼d.; rolled metal, 165s. 0d. per cwt.

Brass (Brazing).—BS1400, B3 (65/35), £139; B6 (85/15), — ; BS249, —.

Brass (High Tensile).—BS1400, HTB1 (30 tons), £188; HTB2 (38 tons), £204; HTB3 (48 tons), — .

Gunmetal.—BS1400, LG2 (85/5/5/5), £172; LG3 (86/7/5/2), £184; G1 (88/10/2/½), £245; (88/10/2/1), £233.

Phosphor Bronze.—BS1400, PB1 (AID released), £256 per ton.

Phosphor Bronze Strip, etc.—Strip, 241s. 0d. per cwt.; sheets to 10 w.g., — per cwt.; wire, 3s. 7⅜d. per lb.; rods, 2s. 11d.; tubes, 2s. 11d.; chill cast bars: solids 2s. 10¾d., cored 2s. 11¾d. (CHARLES CLIFFORD, LIMITED.)

Nickel Silver, etc.—Rolled metal, 3 in. to 9 in. wide × 0.056, 3s. 6½d. per lb.; round wire, 10g. in coils (10 per cent.), 3s. 11d.; special quality turning rod, 10 per cent., ½ in. dia., in straight lengths, 3s. 10d. All prices are net.

Other Metals.—Magnesium, ingots, 2s. 5½d. per lb. Antimony, English, 99 per cent., £210 0s. 0d. Quicksilver, ex-warehouse, £80 0s. 0d. Nickel, £600 0s. 0d. Aluminium ingots, £197 0s. 0d.; aluminium bronze (BS1400), AB1, — ; AB2, £256.

* Average 68-70 per cent.